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THE INFLUENCE OF FITNESS PROGRAMS ON THE PHYSICAL DEVELOPMENT AND STRENGTH CAPACITIES OF ADULT WOMEN

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The defense of the thesis will take place on 13.06.2024, 13:00 a.m., aud. 105, in the meeting of the Public Support Commission within the State University of Physical Education and Sport of the Republic of Moldova (Str. A. Doga 22, Chisinau, MD-2024).

The doctoral thesis and the abstract can be consulted at the Library of the State University of Physical Education and Sport and on the website of ANACEC.

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Content

INTRODUCTION

Current affairs in research. All the devices and systems of the adult woman's body are positively influenced by practicing physical exercise at least twice a week, even at a low intensity. But by practicing weight training, adult women manage to achieve remarkable results in gaining muscle mass.

The topic is current due to the fact that it offers a sustainable alternative as time allocated to physical muscle strength exercises. We believe that the proposed topic is of interest and can be a possible support for adult women, and not only, who want to improve their parameters of muscle strength, muscle mass, body composition and well-being.

The purpose of this paper is to verify the hypothesis that the development and implementation of the circuit type fitness program can lead to physical development, strength capabilities, the development of muscle mass, muscle strength and at the same time reduce the time allocated to training. The aim is also to reduce adipose tissue, improve the body mass index, obtaining results similar to or superior to those reported in previous studies.

Research objectives

1. Study and deepen the specialized literature for muscle strength training involving adult women.

2. Surveying fitness instructors and female fitness trainers to analyze their opinion.

3. The development of a training program aimed at improving the physical development of the strength capacities of adult women and shortening the working time.

4. Arguing the sustainability and effectiveness of the program by applying circuit training to improve the physical development and strength capacities of adult women.

Research hypothesis

It is assumed that by applying this program, we will achieve superior results to those achieved by the classical method of strength training. Thus, we will have the conviction that this training program will increase the participation rate of adult women and more.

It will have an effect on the physical development and strength capabilities of adult women by changing body composition, increasing muscle mass and changing the ratio of fat mass to muscle mass. The effect can also be beneficial on muscle strength by increasing it.

Also, the program can lead to the optimization of certain physiological parameters that have a special contribution in improving the general condition, the state of physical and mental health as well as increasing the quality of life.

Scientific novelty and originality: involves the development and application of a circuit training program that can provide shorter work time, physical development, increased strength and muscle mass, achieving results similar to or superior to the classic structure. The results obtained following the application of this program lead to the solution of the problem aimed at improving the physical development, strength capacities of adult women and shortening the working time.

The current scientific problem solved is to implement a circuit training program to obtain results of increasing the physical development and strength capabilities of adult women, in the shortest possible time.

Theoretical Significance: Establishes that streamlining and shortening the time spent on strength training benefits the physical development and strength capabilities of adult women, as well as the time spent training.

Implementation of the results: these were implemented among adult women who want to improve their physical development, muscle strength capabilities, through training programs as well as among people who want to increase their physical and mental well-being. At the same time, it is a program aimed at people who want to adopt a healthy lifestyle. The program took place in the ABC Suceava fitness room.

Research methodology: In order for this study to include both the research done in the field and the results of the applied program, we used several methods and means, starting from the bibliographic method followed by that of the questionnaire, the experiment method (case study), the analysis method and synthesis, empirical, statistical-mathematical, interventional and graphic-tabular and statistical-mathematical. The research methods used in the present study are multiple precisely to obtain broad-spectrum data on the monitored parameters and the evolution of the subjects involved.

The potential scientific results estimated to be obtained by applying the circuit training program can be achieved positive results in terms of increasing physical development and strength capabilities, gaining skeletal muscle mass and also muscle strength. Another

important aspect pursued is improving the general condition and adopting a healthy lifestyle through movement.

Analytical Approach: In an attempt to determine the most effective strength training program, we will resort to studying this circuit training program. The exercises are performed with specific strength arranged in a circuit-type program and applied among adult female subjects with a moderate level of physical activity.

With countless references to women achieving slower gains in muscle strength and muscle mass, we're going to introduce the progressively heavier exercises into a circuit training program, and later track the progression for muscle strength through various tests.

Taking into account the current social context in which the woman has many domestic and social attributions, we try to highlight a successful program in increasing physical development and strength capabilities, redistributing body composition, increasing resistance to effort, increasing strength and increasing muscle mass, relative to time spent in the gym.

Muscle strength and mass are parameters that influence long-term health. Specific strength exercises stimulate muscle protein synthesis, thus being a necessary stimulus in increasing physical development and strength capabilities.

Force refers to overcoming resistance, not conditioned on time, and power refers to mechanical work done per unit of time.

Strength-specific exercises attenuate the loss of lean skeletal mass during an energy deficit, the mechanism being the stimulation of muscle protein synthesis. The combination of increased protein intake and strength-specific exercise could have a synergistic effect on muscle protein synthesis resulting in a favorable ratio of fat to lean mass lost.

We will investigate whether the application of a weight circuit training program to adult women of similar age and activity level will produce changes in physical development, muscle strength and muscle mass similar to those of classical muscle hypertrophy training.

Thus, we will select a number of female subjects of relatively similar age and physical activity level, which we will subject to a physical exercise program. The subjects will be divided into 2 groups, in order to apply different work strategies. Through the two groups, we will find the difference in the response to the strength-specific exercise programs and the one in the circuit.

The exercise program will last 6 months, 28 weeks, and will include 2 training sessions per week. Training sessions will have different structures for the muscle groups monitored.

The first group will initially be used as a support/control group, and the second group will be experimental and use circuit strength training as a training program, and work time will be shortened.

Training sessions will be held for groups on the same day of the week and at the same time of day. Thus, we will maintain an identical protocol throughout the program for all subjects in the program without jeopardizing data collection.

We structured the training differently for the two groups, as follows: if one group will have a muscle strength training session in the initial training program, the other group of subjects will benefit from the circuit muscle strength training session, but with a reduced Subjects in the control group began the training session with a warm-up session specific to progressive load hypertrophy training by performing the same exercise with a light weight.

The subjects of the experimental group started the training session with a warm-up session similar to the control group and the training will be one circuit. We have also introduced muscle activation exercises to increase the stimulus applied to the muscles and they will be done with elastic bands of different difficulties. The training volume will be lower compared to the control group because the circuit training is more demanding in terms of muscle effort parameters.

The training program will involve several muscle groups. Major and minor muscle groups, both superior and inferior. We will use specific equipment for each muscle group, such as: chest push on the machine with adjustable weights, from a seated position; traction device in the vertical plane from sitting with support on the chest; shoulder press, to the machine, from sitting; forearm curls on the arm for biceps with fixed weights and push-ups for the leg press from lying horizontally with the trunk position at 900 but also free weights such as dumbbells and barbells.

Testing: We initially tested the subjects through various muscle strength tests, tests that will be repeated at the end of the program to determine progress.

In order to establish progress on the body composition side as well, we made initial and final measurements, measurements that indicate body composition and muscle size by segment.

The anthropometric measurements were made with the centimeter tape, and the measured areas are; chest circumference, biceps, thigh and waist circumference.

I also recorded the body composition using the TANITA MC-780 Body Composition Analyzer. The device uses the bioelectrical impedance method (BIA).

Bioelectrical impedance (BIA) is a commonly used method for estimating body composition. Since the first devices became available in the mid-1980s, the method has become popular due to its ease of use, the portability of the equipment, and its relatively low cost compared to some of the other body composition analysis methods. BIA actually determines electrical impedance, or opposition to the flow of electrical current through tissues, which can then be used to estimate total body water (TBW), fat-free body mass, and body fat.

At the end of the intervention period, the testing of the subjects was repeated with the exercises that are the subject of this paper, adapting the weights of the subjects' evolution.
We also applied the self-assessment testing method using a questionnaire. Thus, the subjects had the opportunity to self-evaluate their well-being and self-confidence.

The training took place in the ABC Fitness Suceava gym, located in the central area of the city and having the capacity to accommodate approximately 300 people/h in the training space. It is a gym that has numerous strength machines as well as various equipment that can be used to perform free exercises.

Approval of the scientific results: the implementation of the programs was carried out among adult female subjects who voluntarily participated in the training program that took place in the ABC-fitness gym, in Suceava. The results obtained as well as other important materials were published in different communication sessions in national and international specialized journals with the article title as follows:

The Annals of the "Ştefan cel Mare" University of Suceava, The Science and Art of Movement, Volume XI issue 1, 2018, p. 11-22. ISSN 2601 - 341X, ISSN 1844-9131

The Annals of the "Ştefan cel Mare" University of Suceava, The Science and Art of Movement", Volume XV issue 2, 2022, p. 37-42, ISSN 2601 - 341X, ISSN 1844-9131

Bulletin of the Transilvania University of Braşov. Series IX: Sciences of Human Kinetics, Vol. 15(64) No. 2 2022, p.75-82. ISSN 2344–2026

Science of physical culture State University of Physical Education and Sport, Chisinau, Republic of Moldova, in progress of publication. ISSN 1857-6438

"Sports. Olympism. Health": Materials of the International Scientific Congress (September 10-12, 2020). Chisinau: USEFS, 2021, p. 629-638. ISBN 978-9975-131-98-8

Health. Sports. Recreation: 4th International Online Conference (May 14, 2021). Belgrade, Serbia: CSH, 2021, pp. 82-87. ISBN 978-86-83687-31-2

Sports. Olympism. Health: International Scientific Congress. Collection of articles, 7th Edition, September 15-17, 2022, Chisinau, p. 123-125. ISBN 978-9975-68-460-6

Summary of the sections of the thesis

The introduction presents aspects of topicality and importance of the topic addressed, the purpose of the thesis, the pursued objectives and the research hypothesis. The scientific originality of the work, the proposal by which the hypothesis of the work will be solved as well as the implementation of the research results at the practical level are also scored.

Chapter 1. We find information on the impact of fitness programs on adult women, data from previous research on this topic, and aspects of muscle mass gains among women. Data are also presented regarding the physiological response of the devices and systems that are involved or can be influenced by the involvement of adult women in fitness programs. The benefits and impact that physical exercise has on overall health, on the system; muscular, bone, cardiovascular, endocrine, reproductive as well as respiratory and digestive systems. Data on the general exercise physiology of adult women are reported.

Chapter 2. The stages of the research are presented by developing the methodology that follows the fitness programs in which adult women participate. It contains data on the number of participants in the present study, the location and the working methods. Also in this chapter, data are presented regarding the results of the questionnaires applied to both fitness instructors and women participating in different fitness programs within specially designed spaces. The results of these data as well as those obtained after testing the muscle strength of a large number of adult women bring more clues in building the work strategy. Establishing the working protocol as well as the initial testing of the working group are the next steps found in chapter 2.

Chapter 3. This last chapter contains data regarding the verification and argumentation of the effectiveness of the program applied to the participating subjects, respectively adult women. Description of the work sample through concrete data related to the subjects and evaluation of indices from the final testing. Data are found on the pretest and posttest of the working groups, i.e., the control group and the experimental group. This data establishes the veracity produced from the initial to the final testing. It is found after the experiment that the data obtained in the case of both groups are increasing and in the case of the experimental group, some results have a much more positive character than in the case of the control group, which leads to the fulfillment of the hypothesis according to which the strength training structure can be modified in intensity and volume and better results can be obtained than those of a classic muscle strength training.

The conclusion of the thesis is made with general conclusions and practical and methodical recommendations for adult women who want to improve their parameters related to physical development, muscle strength, muscle mass and body composition.

1. THEORETICAL, METHODOLOGICAL AND SCIENTIFIC ASPECTS OF STRENGTH TRAINING APPLICABLE TO ADULT WOMEN

Impact of fitness programs on physical development and strength capacities in adult women

The physical development of adult women aged 31-50 years was tested by Toprak et al. by applying a circuit training program for 16 weeks. The 29 women included in the study recorded superior results for the monitored parameters. [34]

Posnakidis G. and colleagues also investigated the impact of circuit fitness training to see if it has an effect on parameters of physical development and neuromuscular performance without producing inflammation or muscle damage. This program has been shown to be effective in improving physical development. [28]

In recent years, AF strength training has gained major importance in addressing a healthy lifestyle and improving general physical condition [1,2]. For women, PA brings countless benefits, one of which is increased muscle strength [12], bone mineral density [38], improved maternal recovery and perinatal outcomes during pregnancy [27], changes in body composition [7], as well as the improvement of other aspects related to life in old age [8], but also in the case of women who have survived breast cancer [9].

Optimizing PA depends on how variables such as order and selection of exercises, rest interval, training volume, number of exercises performed in a session are manipulated [11,36]. Countless studies and discussions have sought to find an optimal dose between training volume and AF results [27,30,31].

This type of training, namely strength training or that with added weights, has an impact on both the muscles and the nervous system and the bone system (tendons, ligaments). Such type of training in order to be built correctly needs some rules and knowledge of the principles of composition.

Although women's ability to work with weights is at least equal to that of men, they are more conservative and reluctant to work with challenging weights. Some studies have highlighted women's hesitancy in working with weights. In the process of self-selection of working weights, women frequently choose much lower values of weights thus limiting real strength gains [20,25].

In the case of adult women who are part of the beginner category, a relatively small amount of training is needed, 2-3 training sessions per week and per muscle group, with a low intensity, i.e. a total of 20 repetitions and a volume consistent with beginner level, 1-2 total

sets. If we are talking about training for a healthy body, then we can keep the frequency of 2-3 weekly sessions but we will approach a higher intensity with a higher number of sets per muscle group. In the case of women in the intermediate stage, the approach changes, they can practice several workouts per week but the frequency per muscle group is low. For those in the advanced or performance category, the frequency is an increased one with the highest potential number of sets and repetitions [23,35].

Another important aspect that we must remember, and that women would be advised to take into account, is that of addressing the added load during strength training. We recall from previous discussions that many women use weights far below their capacity being more conservative than men.

2. DEVELOPMENT OF THE METHODOLOGY FOR THE IMPLEMENTATION OF FITNESS PROGRAMS WITH THE PARTICIPATION OF ADULT WOMEN

Methodology for application and implementation of the proposed program

In the present study, 38 female volunteers were recruited from an adult population with a history of exercise. During the training period as well as the data analysis, 2 subjects were excluded due to failure to complete at least 90% of the training sessions. Thus, 36 subjects completed the present study. The 36 subjects were divided into two groups as follows: control group 18 subjects and experimental group 18 subjects. This sample size was justified by a literature review.

We used age between 30-50 years, average fitness level and compatibility with this type of training as eligibility criteria. Exclusion criteria were: training history of less than one training session per week in the last 3 months, impaired muscular endurance caused by previous injuries, chronic joint diseases, pregnancy, amenorrhea, intake of drugs that could interfere with training and the intra- and post-training recovery period as well as non-attendance at training sessions in a percentage of 90%. The included participants indicated previous experiences in practicing fitness at a recreational level.

The application of the program started on 03.10.2022 and ended on 08.04.2023. We applied two monitorings, an initial one at the beginning of the program and a final one at the end of the program.

The venue of the training sessions was the ABC fitness Suceava gym.

The intervention program was applied to the experimental group for 28 weeks, for the whole body with separate sessions addressed to the upper and lower body. In the selection of the exercises, we took into account the facilities of the fitness center where the training took

place, but also the possibility of having an accurate and correct monitoring of the progress in progressive loading. Thus, I predominantly used machines with fixed and adjustable weights and less free weights. Muscle strength was assessed at the beginning and at the end of the 28 weeks. Body composition was also monitored at the beginning and end of the study taking into account the hormonal context and the phase of menstruation that must be identical in both stages of data collection. In some cases the body composition measurements were delayed by 2-5 days but did not exceed this period, and this happened due to the personal hormonal context.

From week 3 subjects received nutritional advice and guidance on a high-protein diet [18]. The diet was released by registered nutritionist-dietitian Ghervan Mihai-Florin and provides guidelines for 3 main meals and a snack.

Table 1. Motor tests for strength, body composition and physiological indices

Forms of manifestation	Forms of manifestation	Forms of manifestation	Forms of manifestation
Maximum strength	The one repetition maximum test 1RM (kg)	Pushed for the chest to the machine	- pectoralis major
		Traction in the vertical plane	- teres major, trapezius, latissimus dorsi.
		Pushed by the shoulders	- brachial biceps
		Dumbbell forearm curls for biceps	- quadriceps, tailor's muscle, biceps femoris
Explosive force	Eurofit battery(cm)	The standing long jump test	-quadriceps, tailor's muscle, femoral biceps, glutes, gastrocnemius
Segmental force	Eurofit battery (cm)	The dynamometer test	- interosseous muscles, biceps brachii, triceps brachii
	Eurofit battery (seconds)	Test held in hanging	-trapezius, latissimus dorsi, abdominal muscles, intercostal muscles and forearm muscles.
	Planck fitness test (seconds)	Planck fitness test (seconds)	-pectoral, abdominal muscles, triceps brachii, intercostal muscles and forearm muscles.
Force in resistance mode	Sit ups test (repetition)	Trunk Raise Test	- abdominal muscles, gluteus maximus muscle
	Fit Test (repetition)	The biceps test	- brachial biceps
Body composition	Bioelectric impedance method (kg, %)	Body composition assessment	-the whole body
	Centimeter tape method (centimeters)	Evaluation of the dimensions of the involved segments	Upper limbs, chest, waist, lower limbs
Physiological indices	Heart rate monitoring method (bpm)	Heart rate measurement and monitoring (bpm)	

In table 2.1. data are presented regarding the tests applied to evaluate progress in the case of both work groups as well as data regarding the muscles involved in the testing[5]. The tests were completed by both working groups, namely the control group and the experimental group under similar conditions and duration.

Analysis of fitness instructors' and adult women's opinions on fitness program compatibility

I developed a questionnaire that was applied only to Romanian and international fitness instructors. The application of this questionnaire is useful to gather information about: the age with the greatest presence in approaching fitness programs; preferred type of programs; their goals when starting such a program; the dropout rate in such a program as well as the age with the highest dropout rate; if there is a difference in concentration or strength or resistance work, during a month of work, and what age shows the biggest difference; frequency of training sessions per week.

In order to have an overview from the point of view of both fitness instructors and subjects practicing such programs, we also built a questionnaire for female subjects attending fitness centers. The questionnaire was distributed to a number of 90 female subjects from adult age categories and with any level of education. We specifically sought subjects who had not worked with fitness instructors precisely to find out what they want and what they lack when they go to a fitness center without being involved in a program and without being well informed about to training techniques, dosage of effort and frequency. The period of application of this questionnaire is 01.07.2021 and until 01.08.2021, the date on which we completed the collection of materials from the subjects.

The data collected from the fitness instructor survey indicates a greater interest of females compared to males in programs conducted under the supervision of a specialist supporting the present study with female subjects. But, analyzing the aspect related to age, we will notice that in both categories of respondents, the age with the greatest interest in exercise and fitness programs is presented by adult women in the 30-40 years category. The percentage of this age category is 44.44%.

Analyzing the results, we notice that 55.55% of women participating in the questionnaire prefer a number of 2-3 work sessions per week, and the preferred muscle groups are those of the lower limbs and the abdominal muscles. These data are consistent with the proposed program that involves two training sessions per week. The main purpose for which women access fitness programs, whether with specialized staff or free schedule, is weight

loss. Although these data are in contradiction with the proposed program, we want to demonstrate the effectiveness of such a program that can also be used during a hypercaloric diet. This type of program that uses added weights supports the woman by preserving skeletal muscle mass and increasing strength capabilities. Circuit training is also more energy consuming than training with your own weight [15,19,32,37].

Fitness instructors report an 82.53% share of a difference in task management over the course of a month. Knowing the hormonal context of the adult woman we will consider these aspects related to the hormonal context in the application of the final evaluation of the parameters of muscle strength, physiological indices and body composition. The specialized literature supports such an approach of monitoring the hormonal context and managing situations according to specific female hormonal periods [10,16,23,29].

The results desired by the people surveyed are expected in a balanced period as well as duration, of 3-6 months, aspects observed following the survey of the subjects where the share of women who have this objective is 46.66%. They can bring about the desired changes in physical appearance, improving health parameters and generating a balanced lifestyle.

Regarding the aspect related to age, we will note that in both categories of respondents, the age with the greatest interest in exercise and fitness programs is presented by adult women in the 30-40 years category. The percentage of this age category is 44.44%.

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Pre-assessment of the group of adult women attending fitness rooms

Testing was done with the consent of the adult women involved and following the standard 1RM testing protocol, which was explained prior to testing. The testing was also carried out under supervision. The test to which the people were subjected is 1RM for four main muscle groups.

Table 2. Values withheld from 1RM testing

The 1RM test for	X ± б
Leg press push (kg)	57,73±5,31
Traction in the vertical plane of the device (kg)	26,01±3,25
Machine chest press (kg)	24,55±3,17
Chest lifts, for the abdomen, on the machine (kg)	19,57±3,29

x- arithmetic mean; б – standard deviation

In table 2.2. data showing the group mean of the 154 women tested by the 1RM test are presented. Thus, we calculated the arithmetic mean and standard deviation for all samples from the 1RM test applied to muscle groups.

If we compare the results of previous studies with the results obtained by the 154 adult women, we will notice that the group of women evaluated for the chest push exercise obtained an average of 24.55±3.17 and is, in relation to the group of women tested in Antonino Bianco's study, below the level obtained by them of 27.9±10.0 [6]. Also comparing the results obtained by the 154 women for the leg press exercise, where the arithmetic mean is 57.73±5.31, compared to the group mean of Kwon HR [21] which is 56.8±3.6 kg. The results in both cases can be improved if we take into account that the average age is more favorable in the case of our group.

Development of the muscle strength training implementation model for adult female subjects

Fitness is a field that is in continuous development, trying to cover as many aspects as possible of the modern individual. This branch has clear goals to improve aspects of physical and mental health. More and more research is taking place to find optimal training formulas for different age groups. The research does not stop only on training, but also on the accessories used during it, accessories such as those related to apparatus and equipment. For several years, it has been trying to find an ideal fitness program that can be practiced in gyms for as wide a range of subjects as possible and that also respects the criteria of strength training, weight loss and toning muscular. It also goes on a strong urge to involve the use of weights.

We have created a training program, after analyzing the information provided by other specialist studies and other types of training, by which we will shorten the working time for muscle strength training with the aim of achieving results at least similar to those of classical training . We will increase the attractiveness, tolerance and frequency of training through exercise diversity and a short work time.

In order for the objective of this study to be achieved, a series of clear measures are needed to be taken in building and carrying out the training, as well as the observance of some well-defined principles for the implementation of strength training in the case of adult women who will participate in this study.

Thus, the workouts were designed to shorten the allotted time period by combining different training programs, resulting in a circuit training program that preserves the principles of muscle hypertrophy. We divided the total working period, i.e. 28 weeks, into 4 modules. In each module I changed the exercises worked keeping the training structure of ten work stations and time. 2 training sessions were scheduled weekly. These are distributed at 2-3 day intervals where the top and bottom have been trained. Each session was allocated a number of 10 exercises involving the muscles of the upper limbs, the back and the chest, in one session, and in the second session the muscles of the lower limbs and the abdomen. This type of training was applied only to the experimental group.

Table 3. Training structure for the experimental group

Weekly Training Sessions Training Structure	Weekly Training Sessions Training Structure
Monday – upper train	Circuit training: • 10 stations / circuit • 3 circuits performed • 20 seconds in effort • 40 seconds at rest
Rest between sets	- 120 seconds total rest - 60 seconds working with elastic bands - 120 seconds total rest
Thursday – lower body and abdomen	Circuit training: • 10 stations / circuit • 3 circuits performed • 20 seconds in effort • 40 seconds at rest

In table 2.3. the training schemes for the experimental group are presented, a group that was divided into 2 subgroups and that followed the same training protocol as follows: 10 workstations were established, either machines or workstations with free weights such as barbells and dumbbells. The exercises were explained in the first session, understood and practiced as execution before the start of the training session. The break between exercises was an active one because the participants changed their work station to the next exercise. The break between sets was 3 minutes, of which the first and last minutes were total rest, and

from minute 2 to minute 3 the subjects worked with elastic bands, exercises involving the targeted muscle groups. In each break, from minute 2 to minute 3, only one exercise was worked, being replaced in the next break with a different exercise. The last set of exercises was completed with one minute of total rest followed by one minute of band work.

The exercise circuit is designed so that a muscle group is not worked as the main group in two exercises in a row. They were interspersed and each work station addressed a main group even if the exercise was not an isolated one and involved other secondary muscle groups.

3. EXPERIMENTAL VERIFICATION AND ARGUMENTATION REGARDING THE EFFICIENCY OF THE PROPOSED METHOD ON FEMALE SUBJECTS

The exploitation and experimental argumentation regarding the effectiveness of the proposed method on the development of muscle strength, in the case of adult women

The data were recorded by scoring 3 sets of one repetition each, after the subjects had completed the segmental warm-up steps and reached the maximum weight with which a maximum repetition can be achieved, under conditions of correct execution. The highest value is found in the present data.

The testing took place during 03.10.2022 and ended on 08.04.2023, in the case of both groups. The program started with initial testing and ended with final testing.

Individual patterns of response to the training program are closely correlated with the level of physical development, strength capabilities as well as individual characteristics and exercise tolerance. Thus, the results obtained depend on the individual capabilities of response to effort.

Maximum muscle strength, explosive strength, segmental strength and resistance strength were monitored using tests from the Eurofit Battery. Also with the help of the planck test (of the plank), we measured strength in resistance mode. With the help of the trunk lifting test and the Fit test, we measured strength in speed mode. Testing was done at the beginning of the study as well as at its end, following the same protocol.

The routine of muscle adaptation to the effort as well as the preparation of the muscles for the test was identical in both tests, respectively the initial and the final test. The rest period between series was also observed according to the work protocol.

All testing was adapted to adult women enrolled in the study, and work weights were selected based on self-assessment of exercise capacity. No thresholds or limits were imposed.

Table 4. Intergroup and intragroup analysis of statistical indicators for measurements from strength tests applied to the control group and the experimental group

Nr. crt	Sample tested	The tested exercise	Groups and statistical indicators	Statistical indices			
				TI X± б	TF X± б	t	P
1.	1RM	Machine chest press (kg)	GE	19,78 ±1,65	24,17±1,47	-16,12	<0,001
			GM	19,72 ±1,71	22,89±1,23	-12,88	<0,001
			t	-0,08	-2,36	-	-
			P	>0,05	< 0,05	-	-
		Pull down machine(kg)	GE	19,11 ±1,02	23,17±0,71	-16,30	<0,001
			GM	18,50 ±1,15	22,22±1,40	-14,70	<0,001
			t	1,68	-2,52	-	-
			P	>0,05	< 0,05	-	-
		Sholder press (kg)	GE	11,67 ±1,85	18,33±2,99	-10,92	<0,001
			GM	11,78 ±1,06	16,22±1,56	-15,72	<0,001
			t	-0,24	-2,90	-	-
			P	>0,05	<0,01	-	-
		Biceps curls (kg)	GE	12,06 ±1,11	18,58±1,90	-11.99	<0,001
			GM	11,67 ±1,24	17,22±1,69	-11,37	<0,001
			t	-1,12	-2,41		
			P	>0,05	<0,05		
		Leg press (kg)	GE	53,89 ±3,23	66,67±3,83	-17,60	<0,001
			GM	49,17 ±8,79	62,78±7,52	-15,36	<0,001
			t	-2,19	-2,23	-	-
			P	<0,05	<0,05	-	-
2	Bateria EUROFIT	Long jump test (cm)	GE	148,56±1,89	156,72±1,32	-13,71	<0,001
			GM	148,68±2,26	155,06±2,26	-11,80	<0,001
			t	0,46	-2,92	-	-
			P	>0,05	<0,01	-	-
		The dynamometer test (kg)	GE	26,06 ±2,60	35,56 ±2,99	-8,51	<0,001
			GM	26,17 ±2,90	33,17 ±3,43	-8,40	<0,001
			t	0,10	-3,28	-	-
			P	>0,05	<0,01	-	-
		Test kept hanging (seconds)	GE	10,25 ±1,40	18,81±1,36	-18,31	<0,001
			GM	10,91 ±1,98	16,86 ±2,44	-12,37	<0,001
			t	1,52	-3,45	-	-
			P	>0,05	<0,01	-	-
		Sit ups test (repetition)	GE	17,56 ±3,43	28,72 ±1,67	-14,46	<0,001
			GM	18,44 ±3,97	27,72 ±1,81	-8,91	<0,001
			t	0,73	-1,68	-	-
			P	>0,05	>0,05	-	-
3	Fit Test	Fit test (repetări)	GE	15,72 ±3,03	29,56± 1,04	-17,63	<0,001
			GM	15,39 ±2,91	28,06±2,07	-16,70	<0,001
			t	-0,36	-2,69	-	-
			P	>0,05	<0,05	-	-
4	Test plank	Test plank (seconds)	GE	56,06 ±1,21	64,56±2,57	-14,98	<0,001
			GM	52,83 ±2,36	62,06±3,24	-14,09	<0,001
			t	4,96	-2,83	-	-
			P	<0,001	<0,05	-	-

Note: GE – Experimental group, n= 18; GM – Control group, n= 18

P - 0,05 0,01 0,001 n=18 t 1,74 2,57 3,65 n=18 t 2,11 2,90 3,97

The data presented in table 3.1 are from the 1RM tests done on the exercises included in the training protocol, some tests from the Eurofit Battery, the Fit Test from the test protocol for muscle strength in speed mode and the Plank Test for testing muscle strength in resistance mode .

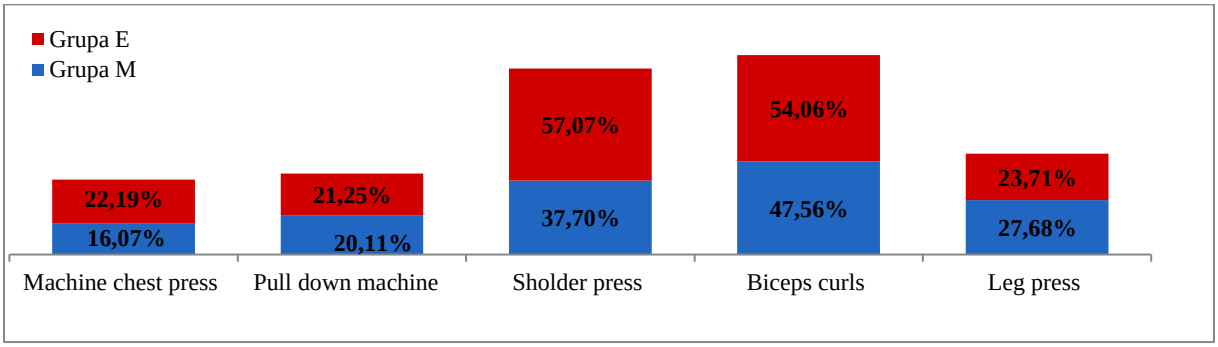

Fig. 1. Graphic representation of the results obtained for the final percentage evolution of the two groups, in the 1RM test

I believe that this graph highlights the progress of the experimental group on all exercises of the test in terms of percentage.

If we analyze the data in graph 1, we notice that all the results of the final testing of the experimental group are higher than those of the control group, less so in the press test for the lower limbs. The experimental group achieved a greater progress by 6.12% compared to the control group in the apparatus chest push test, by 1.14% in the vertical pull test, by 19.37% in the shoulder push test and by 6, 50% in the barbell biceps forearm curl test. The control group shows greater progress than the experimental group in the lower limb press test by 3.97%.

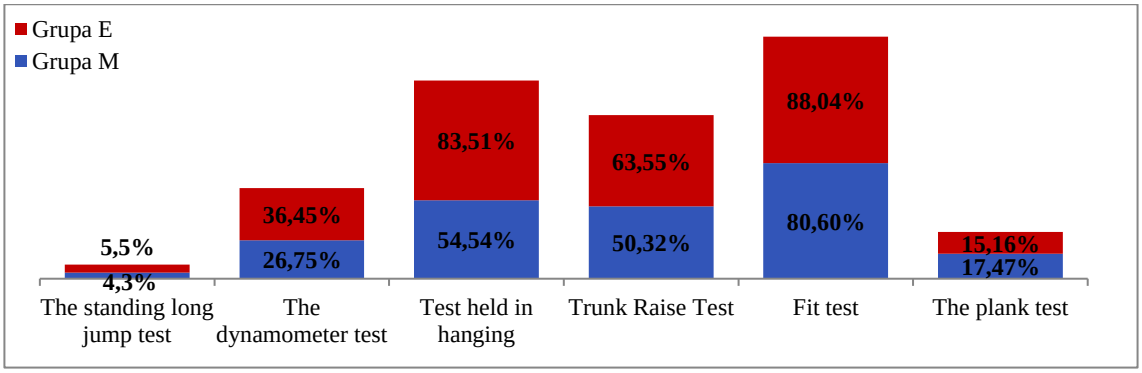

Fig. 2. Graphical representation of the results obtained for the final percentage evolution of the two groups in the muscle strength measurement tests

Figure 2 shows data on the percentage evolution of the two groups in the strength tests. Following these data, we can say that the training method applied to the experimental group is more effective in terms of the results obtained for the standing long jump test by 1.2%, for the dynamometer test by 9.7%, for the hanging test by 28 .97%, for the trunk lift test with 13.23% and for the Fit test with 7.44%. For the plank test, the control group has a 2.31% improvement over the experimental group.

Table 5. Inter-group and intra-group analysis of statistical indicators for determining body composition using the Body Composition Analyzer TANITA MC-780 method.

Nr. crt	**Measured parameters**	Groups and statistical indicators	Indici statistici			
			T_I **X± б**	T_F **X± б**	t	P
1	Total weight in kilograms	GE	65,10±6,36	66,03±5,33	-2,66	<0,01
		GM	64,48±7,67	64,97±6,84	-1,63	>0,05
		t	-0,3	-0,57	-	-
		P	>0,05	>0,05	-	-
2	Total weight in kilograms	GE	23,17 ±1,83	25,62±1,56	-12,75	<0,001
		GM	22,31±1,58	24,06±1,64	-20,7	<0,001
		t	-1,65	-2,8	-	-
		P	>0,05	<0,05	-	-
3	Skeletal muscle mass in %	GE	35,22±3,06	38,66±2,01	-4,17	<0,001
		GM	35,16±2,95	37,12±2,62	-4,37	<0,001
		t	-1,00	-2,21	-	-
		P	>0,05	<0,05	-	-
4	Skeletal muscle mass in %	GE	17,09±5,08	15,93±4,04	3,82	<0,001
		GM	18,31±6,10	17,39±5,39	3,52	<0,01
		t	0,67	0,95	-	-
		P	>0,05	>0,05	-	-
5	Fat mass in %	GE	26,03±5,63	23,73 ± 4,62	5,08	<0,001
		GM	27,76±6,48	26,13±5,81	5,6	<0,001
		t	0,81	1,33	-	-
		P	>0,05	>0,05	-	-
6	Visceral fat index	GE	5,17 ±1,89	3,11 ±1,64	7,8	<0,001
		GM	4,17±1,86	2,28±1,13	9,62	<0,001
		t	2,03	2,63	-	-
		P	>0,05	<0,05	-	-

Note: GE – Experimental group, n= 18; GM – Control group, n= 18

P - 0,05 0,01 0,001

n=18 t 1.74 2.57 3.65

n=36 t 2.11 2.90 3.97

The results of the proposed exercise program were measured by body composition parameters. Measurements were made using a multi-frequency bioelectrical impedance analyzer, Tanita MC-780MA-N, to record the initial and final values of adult women in the research program. The analysis bulletin issued by the device can be found in the appendices.

The measurements took place under identical conditions for all adult women participating in the study, and the order from the initial testing was taken into account in the final testing. Each subject under analysis received the body composition information recorded in a paper-based script format issued by the body composition monitoring unit. The measurements were made with as light clothing as possible and following as much as possible the same approach in the final testing.

Percentage evolution of the control and experimental groups in the final testing

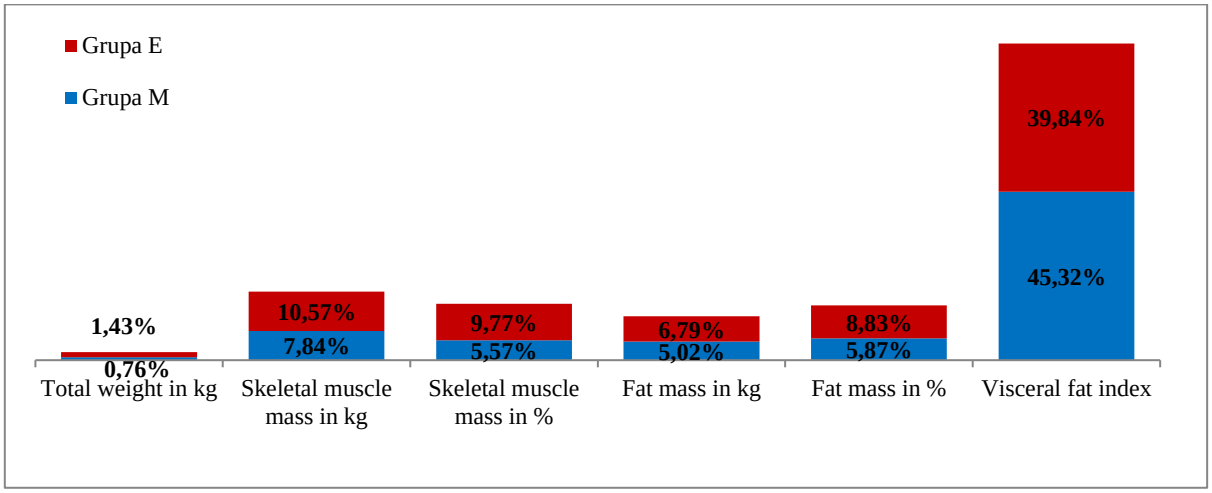

Fig. 3. Graphic representation of the results obtained for the final evolution in percentage of the two groups

Figure 3 shows the percentage results obtained by the groups involved in the research, in the final testing. The values take into account the difference obtained by the experimental group in all parameters measured for the determination of body composition less in that of the visceral fat index. The experimental group has values for the total mass in kilograms 0.67% higher, for the skeletal muscle mass 2.73% higher, for the skeletal muscle mass in percentages 4.20% higher, for the loss of fat mass it registers a higher percentage high by 1.77%, when calculating the percentage of fat loss by 2.96%. The control group obtained a value superior to the experimental group for the visceral fat index by 5,48%. All these gains above the control group confirm the effectiveness of the means used by applying the circuit training program.

Table 6. Intergroup and intragroup analysis of statistical indicators for determining physical and anthropometric measurements

Nr. crt	**Measured segment**	Groups and statistical indicators	Indici statistici			
			T_I **x± б**	T_F **x± б**	t	P
1	Right arm circumference (cm)	GE	28,33±1,68	27,67±1,24	-3,37	<0,01
		GM	28,89±1,23	27,94±1,30	3,18	<0,01
		t	1,21	0,75	-	-
		P	>0,05	>0,05	-	-
2	Back Circumference (cm)	GE	83,06±5,83	79,33±4,43	7,92	<0,001
		GM	84,94±4,17	82,72±4,55	8,89	<0,001
		t	1,05	1,38	-	-
		P	>0,05	>0,05	-	-
3	Waist Circumference (cm)	GE	71,17 ±6,42	67,72±4,92	3,41	<0,01
		GM	73,61±4,02	70,78±4,15	10,01	<0,001
		t	1,35	2,16	-	-
		P	>0,05	<0,05	-	-
4	Right leg circumference (cm)	GE	58,17 ±3,76	56,72±2,97	5,33	<0,001
		GM	58,39±3,91	57,22±3,62	6,30	<0,001
		t	0,16	0,40	-	-
		P	>0,05	>0,05	-	-

Note: GE – Experimental group, n= 18; GM – Control group, n= 18

P - 0,05 0,01 0,001 n=18 t 1.74 2.57 3.65 n=36 t 2.11 2.90 3.97

Table 6 presents data on the evolution of the two groups involved in the study. When measuring the body segments that were tested with the centimeter tape, it was carefully ensured that the location of the tape in the final measurement was identical to that in the initial measurement. When measuring the lower and upper limbs, only the right lower and upper limb was noted.

Figure 4. shows the evolution of the two work groups in terms of body composition tracked by the centimeter tape method. For the circumference of the arm, the experimental group registers a lower percentage than the control group by 0.96%, which may be due to the reduction of adipose tissue in that region or the classical training program achieved better progress. The parameters measured for chest circumference bring superior values to the experimental group by a difference of 2.88% compared to the control group. Likewise, the

experimental group registers 1% higher results than the control group. For leg circumference, the results are close between the two participating groups, although the experimental group obtains a higher value by 0.49% compared to the control group.

These results encourage us to recommend such a circuit training program to adult women who wish to improve their body composition.

Percentage evolution of the control and experimental groups in the final testing

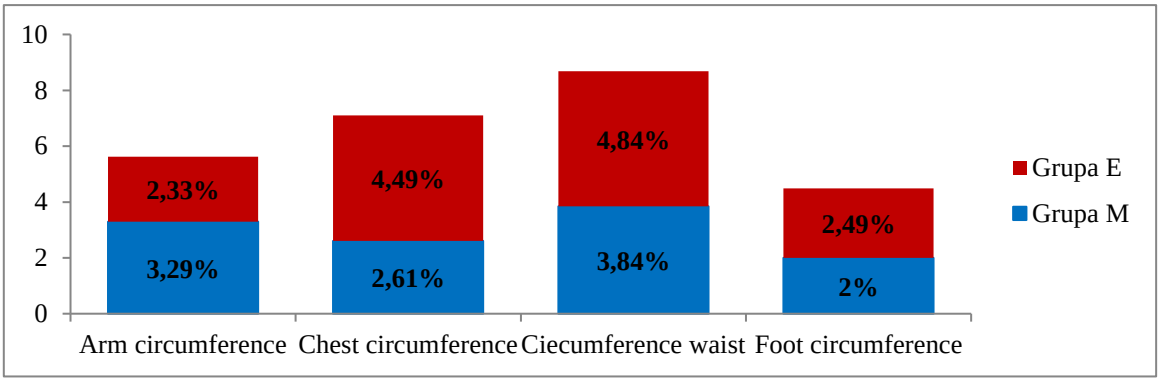

Fig. 4. Representation of the results obtained for the final evolution in percentages of the two groups for the determination of physical and anthropometric measurements

Table 7. Inter-group and intra-group analysis of statistical indicators for the assessment of physiological indices, pulse

Nr. crt	**Measured indices**	Groups and statistical indicators	Indici statistici			
			T_I **x± σ**	T_F **x± σ**	t	P
1	Heart rate at rest (bpm)	GE	64,94±5,48	61,56±2,59	3,24	<0,01
		GM	67,83±6,03	66,56±5,40	4,42	<0,001
		t	1,74	3,50	-	-
		P	>0,05	<0,01	-	-
2	Pulse in activity (bpm)	GE	145,39±5,9	108,61±11,02	18,39	<0,001
		GM	143,67±10,09	117,28±12,16	8,28	<0,001
		t	-0,83	3,71	-	-
		P	>0,05	<0,001	-	-

Note: GE – Experimental group, n= 18; GM – Control group, n= 18

P - 0,05 0,01 0,001

n=18 t 1.74 2.57 3.65 n=36 t 2.11 2.90 3.97

Percentage evolution of the control and experimental groups in the final testing

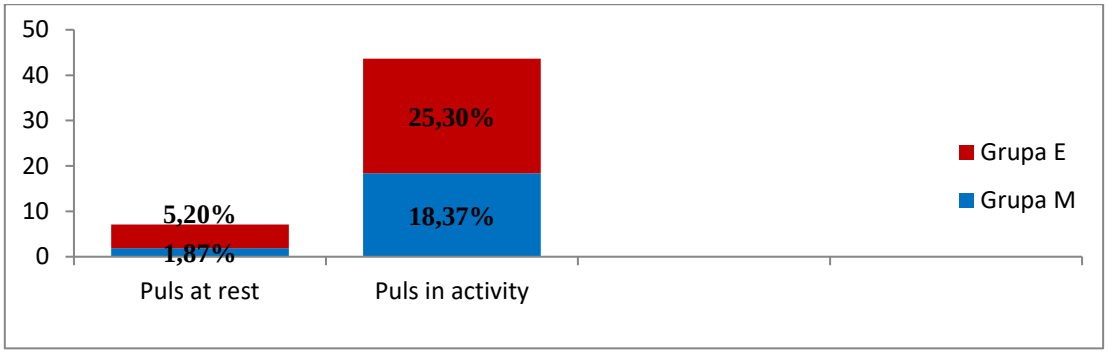

Fig. 5. Graphical representation of the results obtained for the final evolution in percentages of the two groups for the evaluation of the physiological indices, the pulse

If we analyze the data in graph 3.28, we notice that all the final test results of the experimental group are better than those of the control group.

Evaluation of the questionnaire applied to adult women enrolled in the well-being research program

Adult women subjects who are part of the hypothesis research program participated in this questionnaire, i.e. 36 women aged between 30-50 years. Responses were collected at the beginning and end of the program.

Including adult women in a circuit training fitness program improved well-being. Analysis of the baseline and final questionnaires for daytime energy level yields a 58.33% increase for reporting a high level and a decrease of 78.93% for an initially reported low energy level. It also recorded a substantial improvement in sleep quality by 69.47%. Other improved factors are: body image where the percentage of subjects satisfied with their image increased by 25% and those who are generally satisfied increased by 30.56%, subjects also reported progress in carrying out daily activities with ease 38.92%, as well as improvements in mental and physical condition of 47.21%, and the percentage of those who consider it important to collaborate with a specialist increased by 58.33%.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

1. Analyzing the specialized literature, we can state that the particularities related to the organization and implementation of the training program for physical development, strength capacities and muscle mass, among adult women with an average movement history, can be improved. Applying a circuit training fitness program can increase the efficiency of exercise time and improve adult women's relationship with exercise. Although different opinions are found in the literature regarding the technique of increasing muscle strength, the information must be chosen carefully and in favor of the subjects.

2. The results obtained following the application of a questionnaire answered by 63 fitness instructors and 90 women participating in fitness programs in gyms bring important data regarding their preferences regarding the number of training sessions per week, the type of preferred training, time allocated to practice and preferences in working muscle groups.

3. In the preliminary research we evaluated a number of 154 adult women aged between 30-50 years who are participating in fitness programs in specially designed spaces and who have a training program with or without the supervision of an instructor. The evaluated subjects are not included in the present research by applying a differentiated work protocol and have not participated in other research. The results of the testing are represented in the group average and they obtained an average of 24.55 kg in the 1RM test, in the machine chest push-up exercise, for the machine vertical pull-up exercise 26.01 kg, in the leg press push-up 67, 73 kg and for trunk lifts, for the abdomen, on the machine an average of 19.57 kg. Compared to the specialized literature, the results obtained by the subjects participating in the previous study recorded low results for muscle strength.

4. The development and implementation of the fitness program with circuit training for adult women in the experimental group had a positive impact on the final results leading to the achievement of the proposed objectives. Thus, the circuit training program resulted in increased physical development, strength capabilities, increases in muscle strength, and muscle mass among adult women. Also, the fitness program with circuit training led to the improvement of aspects related to body composition, physiological parameters - heart rate at rest and activity, increased self-confidence, increased sleep quality, resistance in performing daily physical activities day, of the body image and the relationship with the staff specialized in the field.

5. Statistical analysis of the results obtained in the experimental study of the implementation of a fitness program with circuit training, which stimulates the increase in muscle strength and muscle mass, were superior in the final testing compared to those in the

initial testing. The "t" test shows significant values for all 10 muscle strength tests at $p<0.05$, $p<0.01$ and $p<0.001$, less in the test of trunk lifts at $p>0.05$. The superior results were obtained by the adult women in the experimental group and are due to the circuit training program implemented. They have values as follows: push for the chest on the machine t=-2.36 where $P<0.05$, traction in the vertical plane on the machine t=-2.52 where $p<0.01$, push for the shoulders t=- 2.90 where $p<0.01$, forearm curls per arm for barbell biceps t=-2.41 where $p<0.05$ and for leg press t=-2.23 where p<0, 05, standing long jump test t=-2.92 where $p<0.01$, dynamometer test t=-3.28 where $p<0.01$, hanging test t=-3.45 where $p< 0.01$ and trunk test t=-1.68 where $p>0.05$, fit test t=-2.69 where $p<0.05$ and plank test t=-2.83 where $p<0.05$.

6. Following body composition tests, adult women in the experimental group achieve superior results following the application of circuit training and show statistical value in 3 of the 6 parameters. Thus, we obtained values for skeletal muscle mass in kilograms t=-2.80 where $p<0.05$, muscle mass in percentages t=-2.21 where $p<0.05$ and visceral fat index t=2.63 where $p<0.05$. Also, the parameters analyzed for adult women in the experimental group have superior results, but not in all cases the value of t is statistically significant.

7. For the monitored somatic and physiological indices, the adult women in the experimental group obtained results above the average of the control group in 4 of the 6 applied tests and obtaining the following values for the somatic indices: waist circumference t=2.16 where $P<0.05$, and for the physiological ones, the values: pulse at rest t=3.5 where $P<0.01$ and for pulse in activity t=3.71 where $P<0.01$.

7. For the monitored somatic and physiological indices, the adult women in the experimental group achieved results above the average of the control group in 3 of the 6 applied tests and obtaining the following values for the somatic indices: waist circumference t=2.16 where $P<0.05$, and for the physiological ones, the values: pulse at rest t=3.50 where $P<0.01$ and for pulse in activity t=3.71 where $P<0.001$.

8. By using this circuit training fitness program, we were able to achieve better results than the classic type and reduce the training time by 14 minutes. This increases the involvement and compatibility with the program of adult women, who aim to improve the level of physical development as well as maintain the parameters related to strength capacity through muscle strength, muscle mass, body composition, improve physiological parameters such as heart rate and increase confidence as well as quality of life.

Following the bibliographic analysis and the conducted experiment, we found that the current scientific problem solved, involves the application of the fitness program with circuit

training, implemented among adult women in the experimental group, to increase physical development, strength capacities by increasing muscle strength , muscle mass but also quality of life.

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1. To increase the efficiency of the time allocated to the fitness program but also to increase the number of women involved in specific strength training programs, we recommend the circuit training program with weights.

2. We recommend using the circuit training program with weights for the development of physical and strength capabilities, for the development of muscle strength and muscle mass, but also for the optimization of body composition.

3. The correct organization of the training program in the circuit is very important, as well as the correct distribution of the exercises so that the same muscle group is not worked in 2 consecutive positions and the time allocated to the exercise and the breaks between sets are respected.

4. The positive results obtained by the experimental group will be a stimulus for adult women, but also for fitness instructors working with women, to adopt such a training strategy.

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ANNOTATION

Ghervan Oana Emilia: ***The influence of fitness programs on the physical development and strength capacities of adult women*****,** doctoral thesis in educational sciences. Chisinau, 2024.

Structure of the thesis: annotation, introduction, 3 chapters, conclusions and recommendations, bibliography composed of 209 sources, 173 pages, basic text 122 pages, 10 tables, 51 figures, 20 appendices. The obtained experimental results are published in 6 scientific papers.

Keywords: physical development, adult women, muscle strength, fitness, muscle mass, circuit training.

The purpose of the research consists in verifying the hypothesis according to which, by developing and implementing the circuit type fitness program, it can lead to the physical development, strength capabilities, the development of muscle mass, muscle strength and at the same time reducing the time allocated to training. The aim is also to reduce adipose tissue, improve the body mass index, obtaining results similar to or superior to those reported in previous studies.

Research objectives:

1. Study and deepen the specialized literature for muscle strength training involving adult women.

2. Surveying fitness instructors and female fitness trainers to analyze their opinion.

3. Development of a training program aimed at improving the physical development and strength capabilities of adult women.

4. Arguing the sustainability and effectiveness of the program by applying circuit training to improve the physical development and strength capacities of adult women.

Scientific novelty and originality: involves the development and application of a circuit training program that can provide shorter work time, physical development, increased strength and muscle mass, achieving results similar to or superior to the classic structure. The results obtained following the application of this program lead to the solution of the problem.

Theoretical significance establishes that by streamlining and shortening the time allocated to strength training, benefits are brought to the physical development and strength capabilities of adult women.

The current scientific problem solved is to improve the physical development and strength capabilities of adult women by implementing the circuit training program and reducing the time allocated to exercise.

The applicative value of the work offers the opportunity for fitness instructors as well as adult women to participate in a strength training program allocating a shorter time to achieve comparable and superior results to those of a classical muscle strength training.

Implementation of scientific results. The results have been implemented among fitness instructors and adult women pursuing physical and strength development and published in a number of national and international scientific conferences and symposia.

АННОТАЦИЯ

Герван Оана Эмилия: **Влияние фитнес-программ на физическое развитие и силовые возможности взрослых женщин,** докторская диссертация в области педагогических наук, 2024, Кишинев.

Структура диссертации: аннотация, введение, 3 главы, выводы и рекомендации, библиография из 209 источников, страницы, страницы основного текста, таблицы, рисунки, приложения. Полученные экспериментальные результаты опубликованы в научных трудах.

Ключевые слова: физическое развитие, взрослые женщины, мышечная сила, подготовленность, мышечная масса, круговая тренировка.

Цель исследования проверить гипотезу о том, что разработка и реализация программы фитнеса кругового типа может привести к физическому развитию, силовым возможностям, развитию мышечной массы, мышечной силы и одновременно к сокращению времени, отводимого на тренировку. Целью также является уменьшение жировой ткани, улучшение индекса массы тела, получение результатов, аналогичных или превосходящих те, о которых сообщалось в предыдущих исследованиях.

Научно-исследовательские цели:

1. Изучить и углубить специализированную литературу по силовым тренировкам мышц, которыми занимаются взрослые женщины.
2. Опрос фитнес-инструкторов и женщин-тренеров по фитнесу для анализа их мнения.
3. Разработка программы тренировок, направленной на улучшение физического развития и силовых возможностей взрослых женщин.
4. Обоснование устойчивости и эффективности программы путем применения круговой тренировки с целью улучшения физического развития и силовых возможностей взрослых женщин.

Научная новизна и оригинальность: предполагает разработку и применение программы круговых тренировок, которая способна обеспечить более короткое время работы, физическое развитие, увеличение силы и мышечной массы, достижение результатов, аналогичных или превосходящих классическую структуру. Результаты, полученные в результате применения этой программы, приводят к решению проблемы.

Решаемая на сегодняшний день научная задача – улучшение физического развития и силовых возможностей взрослых женщин за счет реализации программы круговых тренировок и сокращения времени, отводимого на занятия.

Теоретическое значение устанавливает, что за счет оптимизации и сокращения времени, отводимого на силовые тренировки, достигается польза для физического развития и силовых возможностей взрослых женщин.

Прикладная ценность работы дает возможность инструкторам по фитнесу, а также взрослым женщинам участвовать в программе силовых тренировок, уделяя более короткое время для достижения сопоставимых и превосходящих результатов по сравнению с классической тренировкой мышечной силы.

Внедрение научных результатов. Результаты внедрены среди инструкторов фитнеса и взрослых женщин, занимающихся физическим и силовым развитием, и опубликованы на ряде национальных и международных научных конференций и симпозиумов.

ANNOTATION

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