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Effects of a Combined Exercise Program on Body Mass, BMI and Body Composition of Elderly Women. Is Twice a Week Good Enough?

Efectos de un Programa de Ejercicio Combinado Sobre la Masa Corporal, el IMC y la Composición Corporal de Mujeres Mayores. ¿Es Suficiente Dos Veces por Semana?

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SUMMARY: Ageing is a process that leads to changes in body composition. The study's objective was to determine how combined training program affected older women's body mass, BMI, and body composition parameters. Using the World Health Organization's criteria, the sample included 29 elderly women. The sample was divided into experimental (EG, n=15, 66.26±2.07 years) and control groups (CG, n=14, 66.67±3.74 years). EG was included in a 10-month program of combined exercise, twice a week for 60 minutes. Differences between groups were determined using ANOVA. The effect size between initial and final measurements was determined using Cohen effect size (ES). ANCOVA was used to ascertain the experimental program's effects. Large effects were found for EG in Total Body Fat (%) (ES= .70), moderate effects for BMI, Total Body Fat (kg), Arms Fat Mass (%) and Trunk Fat Mass (%) (ES= .25; ES= .70; ES= .31; ES= .33, respectively). The results of the initial and final testing showed notable and beneficial improvements in EG, in Total Body Fat (kg) (Sig.= .003), Trunk Fat Mass (%) (Sig.= .000) and Trunk Muscle Mass (kg) (Sig.= .008) (p< .01), as well as in BMI (Sig.= .020) and Total Body Fat (%) (Sig.= .019). The combined program, implemented twice per week (less frequency than recommended), lasting 60 minutes per training, for a longer period (10 months) is an effective measure for maintaining body mass and changing body composition and BMI of elderly women.

KEY WORDS: Ageing; Combined training; Aerobic training; Strength training.

INTRODUCTION

The elderly (those aged 65 and over) now represent 12 % of the population. It is projected that, taking into account the growth tendency, it will be 22 % in 2050, meaning that their population would rise from 810 million to 2 billion (United Nations Population Fund, 2012).

Aging is a natural process that leads to various changes in human body. A progressive loss of health-related physical fitness parameters in old people over time (Milanovic *et al*., 2013), which can be defined as specific components of physical fitness related to cardiorespiratory fitness, muscular endurance, muscular strength, flexibility and body composition (American College of Sports Medicine, 2013), is one of those changes. The decline in level of fitness in population of elderly is most pronounced when it comes to muscle strength (Cadore *et al*., 2014) and cardiorespiratory fitness (Hurst *et al*., 2019), and significant losses were also found in agility, balance and flexibility, whereby older women are more susceptible than men (Thomas *et al*., 2019). The aging process combined with the reduction of the aforementioned abilities contributes to the occurrence of falls, which are more common in women (Falcão *et al*., 2019). Additionaly, as people age, their body composition changes. In a study that monitored body composition parameters in old people during two whole decades (Jungert *et al*., 2020), it was found that women lose

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aproximately 4.7 kg of body mass, while in men this reduction amounts to 5.0 kg. At the end of adulthood, and mostly in old age, up to 10–40 % of previous muscle mass is lost (Milanovic *et al*., 2013), which leads to a decrease in the total share of lean mass in body composition, and increase in the accumulation and distribution of abdominal fat, especially in women after menopause (Dupuit *et al*., 2021). Correspondingly, body mass index (BMI) exibits alterations as well.

Due to all of these aging process' modulations, the elderly are more susceptible to various chronic diseases, cancerous diseases, disability, metabolic changes and life quality impairment (Wanderley *et al*., 2015). Typically, the health condition of old people is related to physical inactivity, given that physical activity decreases with age, i.e. the oldest population is less physically active than other ages (Gómez-Rubio & Trapero, 2021). As a matter of a fact, a high prevalence of physical inactivity among the elderly in different regions of the world has been indicated (?liveira *et al*., 2018). Current exercise recommendations for older adults are 150–300 minutes of moderate-intensity exercise or 75–150 minutes of vigorous-intensity exercise per week. Similarly, strength training of moderate or higher intensity, two or more days a week, is recommended for additional health benefits (World Health Organization, 2020). Aerobic exercise increase the cardiorespiratory fitness of the elderly, provoces positive body composition changes (Hurst *et al*., 2019). Regular strength training affects the increase of muscle mass in old people (Cadore *et al*., 2014), while the percentage of fat in the body decreases (Hurst *et al*., 2019). To be more precise, all body composition parameters are modified, which reduces the risk of falls (Andrieieva *et al*., 2019). However, in general, when it comes to elderly's physical activity, a combined training (aerobic and strength training) is recommended. This type of training, i.e. a combination of aerobic and strength training, provides positive effects on body composition, cardiorespiratory system and overall physical fitness of the elderly, which has been confirmed by previous studies (Faramarzi *et al*., 2018; García-Pinillos *et al*., 2019; Dupuit *et al*., 2021). The majority of the studies mentioned above examined the results of combined workout programs that were applied two or three days per week, although for a shorter amount of time (Faramarzi *et al*., 2018; García-Pinillos *et al*., 2019; Jamka *et al*., 2021).

Nevertheless, physical activity is a behavior that is initiated and maintained by the interaction of variouos factors. Besides personal (e.g. initial BMI, fitness, etc.), an environmental factor (e.g. exercise training program format) is the important determinant of behavior change. Namely, the phenomenon of the avoidance of physical activity and exercise is linked to higher intensity of exercise, whereas loner duration isn't (Ekkekakis *et al*., 2016), so the preservation of long-term exercise adherence and lower dropout should be something that has to be worked on because lifetime fitness and wellness is a goal we all strive. According to the authors' knowledge, there is not enough evidence that combined training, if performed twice a week for 60 minutes, for a longer period of time (10 months), would benefit the body composition parameters in older women. Therefore, the purpose of this research was to determine the effects of this exercise training format on body mass, BMI and body composition parameters of elderly women.

MATERIAL AND METHOD

A sample of research participants

The population from which the sample of research participants was selected was defined as the population of old women based on the criteria of the World Health Organization.

The inclusion criteria: women aged 65+ years that have not been involved in any type of organized physical activity at least six months prior to this experimental treatment; only those without cognitive impairments, mental disorders or dementia.

Exclusion criteria: having a musculoskeletal or neuromuscular damage that would make exercise impossible; presence of physical defects or injuries that could hinder the implementation of the experimental program (e.g. paralysis, inability to stand and/or walk, severe pain, etc.); serious health conditions that are not exclusively related to the ageing process (e.g. malignant tumors, dementia, Alzheimer's disease, etc.); being in a recovery phase from some form of acute illness or in a process of rehabilitation from injuries. In addition, respondents who had undergone surgery during the preceding year or who were unable to independently get to the fitness center where the trainings were conducted were not included in the study.

Sample size

An analysis program G*power 3.1 (Faul *et al*., 2007) was used to determine the sample size. An effect size (f) of 0.8 for between-group differences, an alpha level of .05, and a power of 80 % were assumed, so the estimated total sample size was 38 research participants. The sample was increased, because potential dropouts and withdrawal from the study were taken into account.

A total of 50 research participants were included at the start of the experimental treatment due to the anticipated attrition of the sample and were randomly assigned to the experimental (EG, n=25) or the control group (CG, n=25). The EG was included in a 10-month combined exercise program and the CG did not follow any type of exercise program, and they were instructed to continue with their daily routines. Due to dropouts, 29 participants completed the experimental program (Table I): During the experimental program 10 EG particiapnts left the study (three for personal reasons, two due to minor injuries and five particiapnts who did not have a satisfactory number of trainings during the experimental treatment – 80 % of training attendance was minimal for the respondents to be included in the analysis); in the CG, four particiapnts left the research due to personal reasons, and seven were not present at final measurement, so 14 participants from CG were included in the analysis.

Table I. Characteristics of the sample at the initial measurement

	EG (n=15)	CG (n=14)	*Sig.*
Age [years]	66.26±2.07	66.67±3.74	.796
Body Height	163.86±6.54	163.40±4.45	.680

EG – experimental group, CG – control group, Sig. – significance, n – number of subjects. Note: Values are presented as Mean±SD.

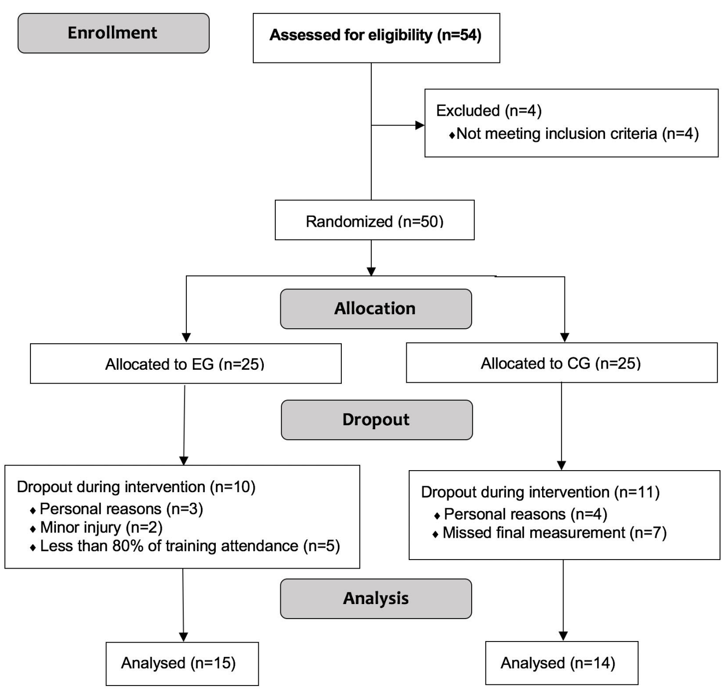

Fig. 1. Flow chart diagram of the participants involved in the research. EG – experimental group, CG – control group, D% – percent of changes between initial and final measurement, ES – effect size, † – trivial effects (r≤ 0.10), & – small effects (0.11–0.25), ‡ – moderate effects (0.25–0.36), ? – large effects (r>0.36). Note: Data are presented as mean values. Black columns represent baseline values, and white ones final.

Randomization

The participants were randomly assigned to the EG or CG. Random selection was performed by asking the respondents to choose a number from an envelope that indicated belonging to one of the groups. A researcher who was not involved in the study enrolled the research participants into groups. Participants from both groups were tested at the beginning of the experiment (initial measurement) and after the last session (final measurement). The process of inclusion and group randomization, as well as withdrawal and exclusion from the analysis for any reason, are presented in Figure 1.

Ethical considerations. The study was approved by the Ethics Committee of the Faculty of Phys. Educ. Sport of University of Banja Luka (No.11/1.30-1/23), and conducted in accordance with the Helsinki Declaration and recommendations for research involving human subjects. Prior to testing, the participants were informed about the possible benefits and consequences of the study. Each respondent consented to voluntary participation in the research and had the option to withdraw from it at any point.

Measures and procedures

The same order and measuring methods were used for all measurements, which were obtained at the start and end of the program. All research participants' body height (in 0.1 cm) was measured with a Martin's anthropometer (GPM, Switzerland), and BMI is calculated as the ratio of body mass (kg) / body height (m2). Body composition parameters were estimated using the bioimpedance method, i.e. Segmental Body Composition Analyzer TANITA BC-418 (Tanita Corporation, Tokyo, Japan). The values of body fat and muscle tissue of the arms and legs were calculated as the mean values of the estimated parameters measured on the left and right sides.

Exercise protocol

For ten months, the EG participated in group exercise sessions that comprised aerobic and strength training, overseen by a professional instructor. Each training session lasted sixty minutes, and there were two training sessions per week. The training regimen included 12 strength exercises for legs, arms and trunk that were done both in standing and lying positions, in addition to 18 aerobic workouts (Table II), and each exercise was performed using only their body weight and without equipment. The formula for calculating maximum heart rate (HRmax) was 220 – age. Throughout the training, heart rate was tracked with heart rate monitors PC-15 (Sigma Elektro, Gmbh & Co, Germany) in order to maintain the proper intensity (the HRmax range for the load intensity was 40–80 %).

Training session structure: the workout was divided into ten-minute warm-up, twenty minutes of aerobic, twenty minutes of strength training, and ten minutes of cooling-down. The **warm-up** included walking and skipping in place, and walking and skipping intervals to mobilize the muscles of the neck, trunk, upper and lower limbs. **Aerobic exercises** were carried out in a standing position with coordinated arm and leg movements performed with load intensity of 40–80 % HRmax range: low intensity loads (40–50 % HRmax) were obtained in the first month; from the second to the fourth month these loads progressed to moderate intensity (50–60 % HRmax), 60–70 % HRmax in the fifth and seventh month,

Table II. Description of the exercise protocol.

	AEROBICS			
	1st month Learning steps	**2nd–4th month** 1–2 sets 5–8x 1 min rest 100–120 bpm	**5th–7th month** 2–3 sets 8–10x 1 min rest 100–120 bpm	**8th–10th month** 2–3 sets 10–12x 1 min rest 100–120 bpm
Intensity	40–50% HRmax	50–60% HRmax	60–70% HRmax	70–80% HRmax
Exercises	Step touch sideways with arm and leg movements in various directions; 1. Foot extension – direct punch, 2. Foot extension – hook punch, 3. Foot extension – cross punch, 4. Foot extension – fist behind opposite ear, 5. Foot extension – arm bending, overhead, 6. Foot extension – extended arm overhead, 7. Foot extension – from shoulders with both arms overhead, 8. Foot extension – from hip semicircular movement in front of the opposite shoulder, 9. Foot extension – arms outstretched hands together behind back, 10. Stance shoulder width apart – alternate front arm raise, 11. Stance shoulder width apart – foot to opposite knee, 12. Stance shoulder width apart – alternate butt kicks, 13. Stance shoulder width apart – from outstretched arms opposite heel touch, 14. Stance shoulder width apart – front knee ups with opposite arms raise above head, 15. Stance shoulder width apart – from outstretched arms touch on one and second lifted knee, 16. Stance shoulder width apart – from hands up position placing hands on lifted knee, 17. Stance shoulder width apart – lifting knee and opposite arm direct punch, 18. Stance shoulder width apart – from hands up position placing hands on the lifted foot.			
	STRENGHT			
	1st month	**2nd–4th month**	**5th–7th month**	**8th–10th month**
Intensity	40–50% HRmax	50–60 % HRmax	60–70 % HRmax	70–80 % HRmax
Exercises	LEGS _ half squat and full squat _ forward lunge _ standing high knees touch _ lateral lunge	1 set 5–8x 30 s rest after each exercise	1–2 sets 8–10x 30 s rest after each exercise	1–2 sets 10–12x 30 s rest after each exercise
	ARMS _ knee push-ups _ standard push-ups _ knee push-ups, elbows out _ lying face-down from kneeling position, chin on chest, bending at the hips, bring the body up into an inverted 'V'	1 set 5–8x 30 s rest after each exercise	1–2 sets 8–10x 30 s rest after each exercise	1–2 sets 10–12x 30 s rest after each exercise
	TRUNK _ abdominal crunch hands to bent knees _ lying straight leg raise _ lying face-down back extension hands on head _ lying face-down alternate straight leg raise	1 set 5–8x 30 s rest after each exercise	1–2 sets 8–10x 30 s rest after each exercise	1–2 sets 10–12x 30 s rest after each exercise

and 70–80 % HRmax in the eighth and tenth month. **Self-body weight exercises** focused on strengthening the lower and upper limbs and trunk with low load intensity (40–50 % HRmax) during the first month; from second to fourth month the strength training was done in the load zone of moderate-intensity (50–60 % HRmax); from fifth to seventh month moderate-intensity load was applied (60–70 % HRmax), and during the last three months of this 10-month exercise program, an attempt was made to consistently stay in the moderate-intensity range (70–80 % HRmax) by doing 1–2 sets of 10–12 repetitions with a 30-second break in between. In a single training session, each strength exercise lasted 20 minutes. Each subject was asked to complete the prescribed number of exercise repetitions without becoming fatigued in order to measure their self-bodyweight resistance. Each exercise was increased by two repetitions in a set over a three-month cycle after the first month until the subjects finished the intended amount of repetitions. Each training session concluded with a 10-minute **cool-down** that comprised two sets of static stretching, lasting 20 to 30 seconds each, for every muscle group that had been worked earlier in the session.

Every month, the exercises' sequence was altered to keep participants motivated. Attendance at training was recorded by the instructor. Heart rate is the basis for controlling the intensity of each workout.

Statistical analysis. Descriptive statistics parameters were calculated for all tests: average value (Mean) and standard deviation (SD). The Kolmogorov-Smirnov test and Levene's test were calculated for all data at the initial measurement and the results showed that the data were normally distributed and that no violation of homogeneity of variance was found. The significance of the differences between the groups at the initial measurement was determined using univariate analysis of variance (ANOVA). The effect size between the initial and final measurements in EG and CG were determined using Cohen Effect size (?S) (Cohen, 2013). The criteria for determining the effect size were: trivial ($r \leq 0.10$), small (0.11–0.25), moderate (0.25–0.36), large effects ($r > 0.36$). Univariate analysis of covariance (ANCOVA) was used to determine the realized effects of the experimental program. Data were processed with the Statistical Package for Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA). The level of statistical significance was set to $p < .05$.

RESULTS

Table III shows the descriptive parameters before and after the intervention. At the initial measurement, no between-group differences were observed (Sig.> .05), which shows that the sample of subjects was well divided by the random method.

Analysis of the differences between the pre- and post-measurements showed that after the 10-month intervention in the EG participants, the large effects were found in Total Body Fat (%), while moderate effects were recorded in BMI, Total Body Fat (kg), Arms Fat Mass (%) and Trunk Fat Mass (%) (Fig. 2). In Body Mass (kg), Legs Fat Mass (%), Legs Muscle Mass (kg) and Trunk Muscle Mass (kg) small effect size was recorded and trivial effects in case of Arms Muscle Mass (kg) (Fig. 2). The percentages between initial and final measurements in EG are in range of 1.9–12.1 %. In CG participants, the size of the effects after the intervention was trivial for Body Mass (kg), Total Body Fat (%), Total Body Fat (kg), Legs Muscle Mass (kg), Arms Fat Mass (%), Arms Muscle Mass (kg), Trunk Fat Mass (%) and Trunk Muscle Mass (kg), while only for Legs Fat Mass (%) small effects were found. The percentage differences between the two measurements in CG participants range from 0.01 % to 4.6 % (Fig. 2).

Table III. Descriptive statistics.

	EG (n=15)		CG (n=14)		
	pre	**post**	**pre**	**post**	***Sig.***
Body Mass (kg)	76.67±10.74	73.11±10.32	79.25±17.17	77.54±17.06	.363
BMI (kg/m^2)	28.49±2.96	27.04±2.61	29.82±6.52	29.07±6.21	.166
Total Body Fat (%)	38.86±4.33	35.82±4.56	40.33±5.97	39.18±6.05	.072
Total Body Fat (kg)	30.23±7.05	26.57±6.69	32.73±12.12	31.21±12.10	.157
Legs Fat Mass (%)	42.23±4.05	40.42±3.75	43.85±5.48	42.16±6.94	.366
Legs Muscle Mass (kg)	7.31±0.61	7.45±0.64	7.38±0.99	7.36±0.94	.810
Arms Fat Mass (%)	38.41±4.47	35.16±5.55	40.34±9.02	39.25±8.60	.464
Arms Muscle Mass (kg)	2.32±0.26	2.38±0.30	2.32±0.35	2.31±0.36	.954
Trunk Fat Mass (%)	36.61±5.15	32.78±5.74	37.25±7.21	36.39±5.82	.065
Trunk Muscle Mass (kg)	24.97±2.16	25.93±2.06	24.92±3.09	24.95±3.02	.223

EG – experimental group, CG – control group, n – number of subjects, Sig. – the level of significance between-group baseline (ANOVA).
Note: Values are presented as Mean±SD

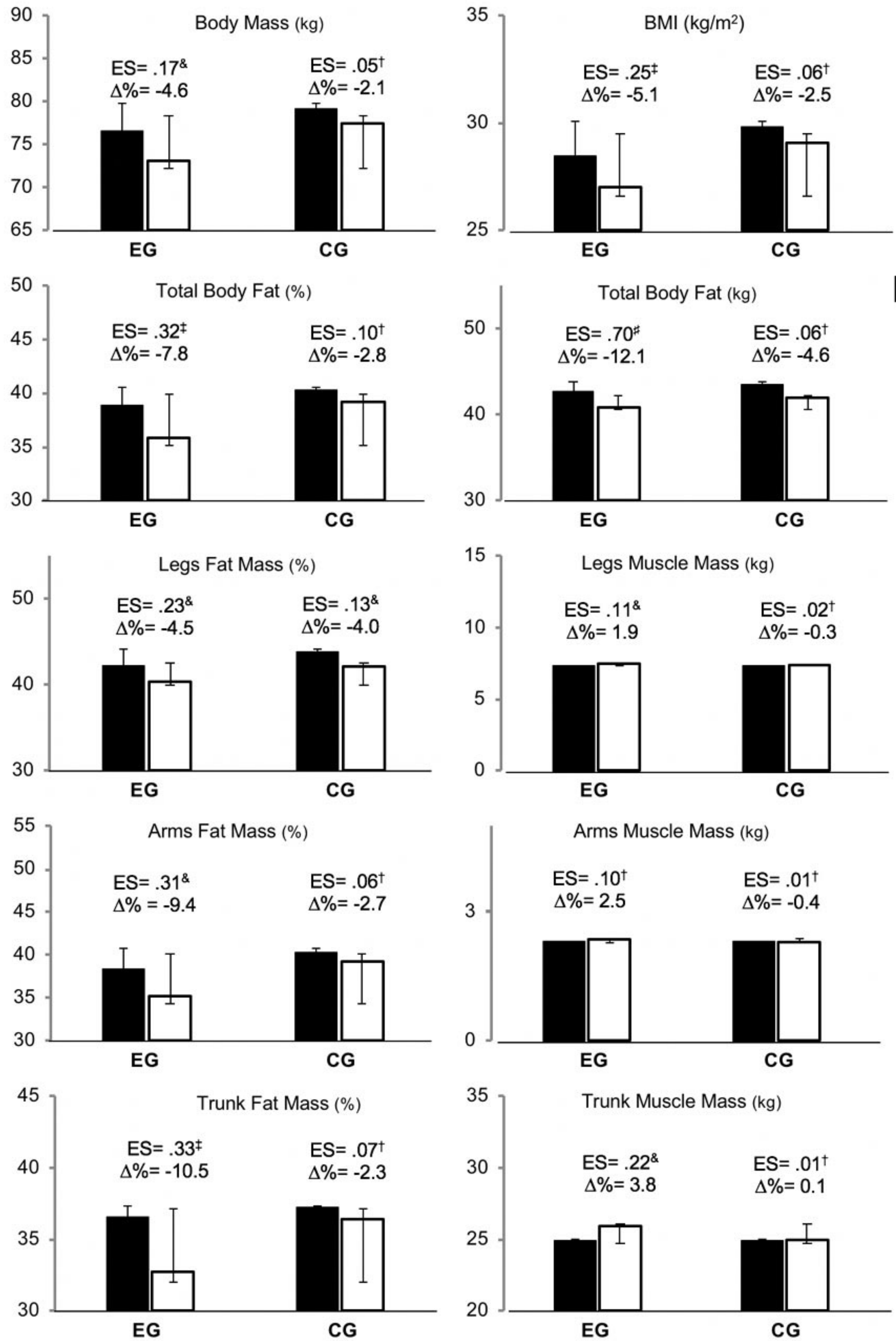

Fig. 2. Effect size and % of changes between initial and final measurements.

ANCOVA identified significant and positive improvements between initial and final testing in Total Body Fat (kg) (Sig.= .003), Trunk Fat Mass (%) (Sig.= .000) and Trunk Muscle Mass (kg) (Sig.= .008) (p< .01), as well as in BMI (Sig.= .020) and Total Body Fat (%) (Sig.= .019) (p< .05) in EG (Table IV). Lower corrected values (Adj Means) were recorded in EG participants in variables BMI, Total Body Fat (%), Total Body Fat (kg) and Trunk Fat Mass (%), which are better results in this case.

No significant improvements were found between the initial and the final testing in Body Mass (kg), Legs Fat Mass (%), Legs Muscle Mass (kg), Arms Fat Mass (%), Arms Muscle Mass (kg) (Sig.= .633, Sig.= .909, Sig.= .230, Sig.= .059, and Sig.= .055, respectively). However, it is noticeable that the adjusted values (Adj Means) are in favor of EG participants. The effects obtained in this way were also determined for the eta squared value (Table IV).

Table IV. Comparison of the effects of exercise programs (ANCOVA).

	EG	CG		
	Adj Means		Sig.	$\eta^{2/p}$
Body Mass (kg)	74.81	75.83	.633	.009
BMI (kg/m²)	27.65	28.45	.020*	.185c
Total Body Fat (%)	36.51	38.48	.019*	.186c
Total Body Fat (kg)	27.77	29.99	.003**	.291c
Legs Fat Mass (%)	41.23	41.35	.909	.001
Legs Muscle Mass (kg)	7.48	7.32	.230	.053-
Arms Fat Mass (%)	36.05	38.66	.059	.126b
Arms Muscle Mass (kg)	2.39	2.30	.055	.130b
Trunk Fat Mass (%)	33.01	36.15	.000**	.612c
Trunk Muscle Mass (kg)	25.90	24.96	.008**	.230c

EG – experimental group, CG – control group, Adj Means – corrected arithmetic means, Sig. – significance. * p< .05, ** p< .01

DISCUSSION

The aim of the study was to determine the effects of 10-month combined training program on body mass, BMI, and body composition of elderly women. The results showed that this program, performed twice a week for 60 minutes, has effects on BMI and body composition parameters. The implemented combined training led to the maintenance of body mass with major changes in body composition. Namely, the 10 months long intervention resulted in a decrease in body fat and an increase in muscle mass. The results indicate that there was a decrease in Total Body Fat (% and kg), Trunk Fat Mass, Arms Fat Mass and increase in Trunk Muscle Mass.

The study's EG participants showed a reduction in trunk fat mass, which is an excellent outcome given that older women tend to accumulate and distribute more abdominal fat tissue, particularly after menopause (Milanovic *et al*., 2013). Similar outcomes were obtained in study of Jamka *et al*. (2021), who applied 12-week strength and endurance training, three times a week for 60 minutes. Although there is no information on muscle mass, the aforementioned experiment showed a shift in body composition and a decrease in body fat.

The results show that there was a change in terms of the decrease in the value of Arms Fat Mass in EG compared to CG, while there were small improvements in the lower limbs. The data obtained in this way are consistent with the results of the study of Nindl *et al*. (2000). Different changes in regional fat and lean mass may be a consequence of the different workload of the training program, i.e. the difference in the amount and intensity of training and the specific exercises that are performed (García-Pinillos *et al*., 2019). It should be noted that there are other factors that can influence differences in body fat loss from different body parts: Genetics can affect the distribution of body fat; some people tend to store more fat in certain areas of the body, such as abdomen or hips, while others may store more fat in legs or arms (Fox *et al*., 2012). Also, older women go through hormonal changes that can affect the distribution of body fat. For example, menopause can lead to an increase in body fat in the trunk, while fat in the legs and arms may change less (Milanovic *et al*., 2013). Namely, a characteristic of aging is that the fat mass is redistributed from the peripheral to the abdominal parts of the body (Jungert *et al*., 2020) and achieved results of the applied program exactly led to a large reduction in trunk fat, less in the arms and insignificant in the lower limbs in women from EG.

When it comes to increasing muscle mass, it is difficult to achieve this goal in the population of the elderly. However, an increase in trunk muscle mass of EG participants was noted and it is possible that this study outcome is due to the length of the implemented experimental program. According to the studies done so far (Cadore *et al*., 2014) changes in body composition have been found after extended periods of exercise. When performing strength exercises, such as weightlifting or self-bodyweight exercises, the muscles in the target area, in this case the trunk, are stimulated, leading to muscle growth and development (Hurst *et al*., 2019), and the increase in muscle mass contributed to the decrease in body fat in this specific area. Thus, the combination of strength exercises and aerobic training in the trunk area resulted in an increase in muscle mass and a subsequent decrease in body fat in that region. More importantly, an increase in muscle mass is directly related to an increase in strength, and vice versa (Keller & Engelhardt, 2013). Similar findings were obtained by Dupuit *et al*. (2021), whose experimental program lasted 12 weeks and included three training sessions each week.

Although, the increase in muscle mass was achieved in the trunk area, it was not the same case with the upper and lower limbs. The reason may be that the goal of the strength training program applied in this study, as well as its' intensity, was not to produce maximal hypertrophy. Also, the elderly women who took part in this 10-month combined exercise program saw a decline in their BMI. This results are consistent with outcomes of two studies which observed BMI improvement in elderly women after 6-month (Tan *et al*., 2012), i.e. 10-week (Faramarzi *et al*., 2018) combined training exercise performed three times per week. Concerning the EG participants' body mass, non-significant alterations were noted, which is in line with the research of Alves *et al*. (2012), carried out for six months, three times a week, while in the research of Faramarzi *et al*. (2018), there was a decrease in participants' body mass. However, weight loss or weight gain can be the result of different methods designed to change body composition, and can depend on the number of training sessions per week, as well as the duration of program itself.

CONCLUSION

The study's objective was to determine the effects of combined aerobic and strength training on older women's body mass, BMI and body composition parameters, and results pointed out that despite obtained alterations in body composition parameters, body mass remained unchanged. After the 10-month intervention in the EG participants, large effects were found in Total Body Fat, while moderate effects were noted for BMI, Total Body Fat (kg), Arms Fat Mass (%) and Trunk Fat Mass. The combined training program reduced overall body fat and increased muscle mass in the trunk area. No effects were noted in CG. However, significant and positive improvements were identified between the initial and the final testing in Total Body Fat (kg), Trunk Fat Mass (%) and Trunk Muscle Mass (kg), and in BMI and Total Body Fat (%). Such results coincided with studies that implemented the program in a shorter period of time (10 weeks, 12 weeks, six months, etc.) with three training sessions per week. The above mentioned indicates that combined training program with a lower frequency (two hours per week), applied during the longer period of time (10 months), leads to positive body composition changes, without alterations in body mass of older women, same as programs that are implemented in a shorter period of time, but with higher frequency.

In summary, the similarity in body composition changes between our 10-month twice-weekly program and other studies conducted three times per week but lasting about 12 weeks or slightly longer, may be attributable to factors such as total training volume, consistency, intensity and individual variation. To fully understand the reasons for these similarities, it is important to consider the specific details of each study and the characteristics of the participants involved.

DJOSIC, A.; ZRNIC, R.; ZIVKOVIC, D.; PURENOVIC-IVANOVIC, T.; ZIVKOVIC, M.; COKORILO, N. & PANTELIC, S. Efectos de un programa de ejercicio combinado sobre la masa corporal, el IMC y la composición corporal de mujeres mayores. ¿Es suficiente dos veces por semana? *Int. J. Morphol., 43(2)*:591-599, 2025.

RESUMEN: El envejecimiento es un proceso que conduce a cambios en la composición corporal. El objetivo del estudio fue determinar cómo el programa de entrenamiento combinado afectaba la masa corporal, el IMC y los parámetros de composición corporal de las mujeres mayores. Utilizando los criterios de la Organización Mundial de la Salud, la muestra incluyó a 29 mujeres mayores. La muestra se dividió en grupos experimentales (GE, n = 15, 66,26 ± 2,07 años) y grupos control (GC, n = 14, 66,67 ± 3,74 años). EG se incluyó en un programa de 10 meses de ejercicio combinado, dos veces por semana durante 60 minutos. Las diferencias entre los grupos se determinaron utilizando ANOVA. El tamaño del efecto entre las mediciones iniciales y finales se determinó utilizando el tamaño del efecto de Cohen (ES). ANCOVA se utilizó para determinar los efectos del programa experimental. Se encontraron grandes efectos para EG en Grasa Corporal Total (%) (ES = .70), efectos moderados para IMC, Grasa Corporal Total (kg), Masa Grasa de Brazos (%) y Masa Grasa de Tronco (%) (ES = .25; ES = .70; ES = .31; ES = .33, respectivamente). Los resultados de las pruebas iniciales y finales mostraron mejoras notables y beneficiosas en GE, en Grasa Corporal Total (kg) (Sig.= .003), Masa Grasa del Tronco (%) (Sig.= .000) y Masa Muscular del Tronco (kg) (Sig.= .008) (p< .01), así como en IMC (Sig.= .020) y Grasa Corporal Total (%) (Sig.= .019). El programa combinado, implementado dos veces por semana (menor frecuencia que la recomendada), con una duración de 60 minutos por entrenamiento, durante un período más largo

(10 meses) es una medida efectiva para mantener la masa corporal y cambiar la composición corporal y el IMC de mujeres mayores.

PALABRAS CLAVE: Envejecimiento; Entrenamiento combinado; Entrenamiento aeróbico; Entrenamiento de fuerza.

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