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**Review article**

# THE EFFECTS OF PHYSICAL EXERCISE ON THE BODY COMPOSITION OF THE ELDERLY: A SYSTEMATIC REVIEW

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**Abstract**. *Body composition is one of the components of physical fitness and it refers to the tissue components which make up the body and is usually used to mark the relative percentage of fat and lean body tissue. In environments of health and fitness, the main interest is the acquisition of knowledge regarding the relative amount of body mass in relation to fat-free mass and the distribution of fat in the human body, with the additional interest in the changes in these components. Physical inactivity is one of the main causes of the increase in body fat. In the case of the elderly, the increase in body fat is conditioned by the slower walking speed and functional limitations. The subject matter of this paper are the studies published in the period from 1991 to 2010 which focused on the effects of physical exercise on the body composition of the elderly, aged 55 to 85. The aim of the paper is to analyze the methods, experimental treatment, results and conclusions which the authors reached in the evaluated studies. The research included a total of 28 papers. The results of the analyzed research indicated that the greatest positive effects on the changes in body composition were determined for exercise programs in combination with an appropriate diet. On the basis of the results of the analyzed research, the optimal duration of the exercise program should be at least 12 weeks, with a frequency of 3 or 4 training sessions per week. The intensity of the exercise in resistance training should progressively increase up to 80%1RM. Each exercise should be performed in three sets of 8 to 12 repetitions. In the case of endurance training, the intensity of the exercise should be at least 80%Hrmax, or in other words, the intensity of the exercise should be moderate to high, with an average training session duration of 60 minutes.*

**Key words**: *body composition, exercise programs, effects, the elderly.*

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## 1. INTRODUCTION

Physical fitness is the ability to perform recreational and daily activities and at the same time not to experience any undesired or excessive fatigue. Physical fitness consists of the following components: cardiorespiratory endurance, muscle skeletal fitness, body composition and weight, flexibility and balance (Heyward, 2010).

According to (Kostić, 2009) both theory and practice indicate that there are four basic components of fitness. These include: cardiorespiratory fitness, muscle fitness, flexibility and body composition.

The long-term fitness and health effects of the performance of appropriate physical activities include the reduction of risk factors of the most significant health problems, the improvement of cardiorespiratory functions, muscle strength and endurance, flexibility and body composition (Howley & Franks, 2007).

Body composition (BC) refers to the tissue components which make up the body and are usually used to refer to the relative percentage of fat and fat-free tissue. Fat-free mass (FFM), fat body mass or fat mass (FM) and the percent of body fat (%BF) are the most frequent components in the evaluation of body composition. The percent of body fat represents the percent of the total body mass which consists of fat. Fat-free mass refers to the mass of fat-free tissue and is known as lean body mass (Howley et al., 2007).

Different methods are used to measure body composition, including: hydrostatic weighing, dual x ray absorptiometry, plethysmography, skinfold measurement and bio-electric impendance (Hofman, 2006).

In environments of health and fitness, the main interest is the acquisition of knowledge regarding the relative amount of body mass in relation to fat-free tissue and the distribution of fat in the human body, with the added interest in the changes in these components Graves, Whitehurst & Findley (2006).

Body fats increase from 16% in the case of men and 25% in the case of women at the age 25 and up to 28% in the case of men and 41% in the case of women at the age of 75. On average, this is approximately 10 kg of fat during the aging process. Fat-free body mass is stable up to the age of 40, after which it decreases by approximately 6% in the case of men and 10% in the case of women aged between 60 and 80 (Holloszy & Kohrt, 1995; cited in Howley et al., 2007).

Physical inactivity is one of the main causes of the increase in body fat. In the case of the elderly, the increase in body mass is conditioned by the slower speed of walking and functional limitations Sternfeld, Ngo, Satariano & Tager (2002). In addition, it is also considered that there are three factors which lead to the increase of body fat during the aging process, including: the increase in an inadequate diet, reduced physical activity and the decrease in the ability for burning fat. Thus, in the case of physical active individuals, the amount of body fat is smaller in a statistically significant manner than in the case of inactive ones Wilmore & Costill (1999).

**The subject matter** of this paper are the studies published in the period from 1991 to 2010 which focused on the effects of physical exercise on the body composition of the elderly, aged 55 to 85.

**The aim** of the paper is to analyze the methods, experimental treatment, results and conclusions which the authors reached in the evaluated studies.

## 2. THEORETICAL CONSIDERATIONS OF THE PROBLEM

In order to collect and analyze the research carried out so far, we used the descriptive method and theoretical analyses. While collecting the existing research, we used the "Google scholar" internet search engine, as well as the following databases: Free Medical, Willey Interscience, Doaj, Springer/Kluwer, Hihg Wire and Medline. A total of 96 research papers were collected, but not all of them satisfied the criteria of this study. The criteria required that the participants be healthy or obese but without any additional health problems, and that they be between the ages of 55 and 85. A total of 25 studies were excluded from the further analysis since the participants had other health problems, including: osteoporosis, rheumatoid arthritis, diabetes, heart conditions and elevated blood pressure. A total of 43 studies were excluded from the further analysis because the participants were under the age of 55 or older than 85. A total of 28 studied satisfied the criteria for further analysis.

The results of the analysis of the collected studies are shown in tables 1. and 2. For the purpose of clarity, table 1. shows the following parameters: references, the sample of participants (their number, age and gender) and the experimental treatment (the duration of the program, the number of groups and the exercise program). Table 2. shows the following parameters for each of the studies: references, a short description of the experimental program, the parameters of body composition which were measured in the studies and the results that the authors obtained.

In the first 19 studies in tables 1. and 2. the experimental program only included the use of exercise programs, without any diet supplementation. In the following 9 studies the experimental treatment included the use of an exercise program in combination with a diet or diet supplementation.

**Table 1.** The sample of participants (the overall number, age and gender) and the experimental treatment (the duration of the program, the number of groups: E-experimental, K-control and the exercise program)

| The research | Sample of participants | | | Experimental treatment | | |
|---|---|---|---|---|---|---|
| References | No. | Age | Gender | duration | No. of groups | exercise program |
| 1. Kemmler, Von Stengel, Engelke, Haberle, Mayhew et al. (2010) | 246 | 65-80 | W | 18 months | 1 E<br>1 C | 1.E - CT<br>1.K -Wellness program |
| 2.Wanderley, Oliveira, Mota & Carvalho (2010). | 22 | 71,4±5,9 | W | 4 months | 1 C | walking |
| 3. Fjeldstad, Palmer, Bemben & Bemben (2009). | 55 | 60-75 | W | 8 months | 2 E<br>1C | 1. E -RT<br>2. E -RT and vibration training<br>3. K -NE |
| 4. Kwon, Park, Kim & Park (2008) | 40 | 70-80 | W | 24 weeks | 1E<br>1C | 1. E- CT<br>1. K -NE |

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| 5. Micheli da Silva, Gurjão, Ferreira, Gobbi & Gobbi (2006) | 30 | 61,1±7,3 | W | 12 weeks | 1E | RT |
| 6. Di Pietro, Dziura, Yeckel & Neufer (2006) | 25 | 75±10 | W | 9 months | 2E<br>1C | 1.E- ET high intensity<br>2.E- ET moderate intensity<br>3.K-stretching exercises |
| 7. Thomas, Hong, Tomlinson, Lau, Lam et al. (2005). | 207 | 65-74 | M/W | 12 months | 2E<br>1C | 1.E- Tai Chi<br>2.E- RT<br>3.K-NE |
| 8. Galvao & Taaffe (2005) | 28 | 65-78 | M/W | 20 weeks | 2 E | 1.E- RT with one set of repetitions<br>2.E- RT with three sets of repetitions |
| 9. Delecluse, Colman, Roelants, Verschueren, Derave et al. (2004) | 79 | 55-75 | M | 20 weeks | 3E<br>1C | 1.E-ET and RT with moderate load<br>2.E-ET and RT with low load<br>3.E-ET<br>4.K-NE |
| 10. Barbosa, Santarem, Filho & Marucci (2001). | 19 | 62-72 | W | 10 weeks | 1E<br>1C | 1.E- RT<br>1.K -NE |
| 11. Hunter, Wetzstein, Fields, Brown & Bamman (2000) | 15 | 61-77 | M/W | 24 weeks | 1E | RT |
| 12. Lyndon, Davey, Evans & Campbell (1999) | 35 | 54-71 | M/W | 12 weeks | 1. E -women<br>2. E -men<br>2 E | RT |
| 13. Jessup, Lowenthal, Pollock, & Turner (1998) | 21 | 68,5±4,7 | M/W | 16 weeks | 1E<br>1C | 1. E-ET<br>1. K -NE |
| 14. Ballor, Harvey-Berino, Ades, Cryan & Calles-Escandon (1996) | 18 | 56-70 | M/W | 12 weeks | 2 E | 1. E -RT<br>2. E -aerobic training |

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| 15. Lan, Lai, Wong, & Yu, (1996) transversal study | 76 | 69,3±3,9 | M/W | 11,8±5,6g | 1 E<br>1 C | 1. E -Tai Chi<br>1.K -NE |
| 16. Hersey III, Graves, Pollock, Gingerich, Shireman et al. (1994) | 42 | 70-79 | M/W | 6 months | 2E<br>1C | 1.E -ET<br>2.E -RT<br>1.K-NE |
| 17. Poehlman, Rosen & Copeland (1994) | 18 | 66,1±1,4 | M/W | 8 weeks | 1. E -women<br>2. E -men<br>2 E | ET |
| 18. Kohrt, Obert & Holloszy (1992) | 93 | 60-70 | M/W | 9-12 months | 1. E -women<br>2. E -men<br>2 E | ET |
| 19. Poehlman & Danforth ( 1991) | 19 | 64±1,6 | M/W | 8 weeks | 1E | ET |
| 20. Iglay, Apolzan, Gerrard, Eash, Anderson et al. (2009) | 36 | 61±1 | M/W | 12 weeks | 2E | 1.E- RT and a low-protein diet<br>2.E-RT and high protein diet |
| 21. Solomon, Sistrun, Krishnan, Aguila, Marchetti et al. (2008) | 23 | 65-68 | M/W | 12 weeks | 2E | 1E- ET with normal calorie intake<br>2.E- ET with reduced calorie intake |
| 22. Rogers, Bohlken, Beets, Hammer, Ziegenfuss et al. (2006) | 44 | 55-84 | M/W | 12 weeks | 3E | 1.E-RT and the intake of creatine<br>2.E-RT and the intake of creatine and botanic extracts<br>3.E- RT |
| 23. Sartorio, Maffiuletti, Agosti, Marinone, Ottolini et al. (2004) | 20 | 61-75 | W | 3 weeks | 3E | 1.E -CT and a diet<br>2.E and 3.E -CT, diet and the intake of supplements |
| 24. Eijnde, Van Leemputte, Goris, Labarque, Taes et al. (2003) | 46 | 55-75 | M | 1 year | 2E | 1.E-CT and creatine supplements<br>1.E -CT |

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| 25. Brose, Parise & Tarnopolsky (2003) | 28 | 65 and older | M/W | 14 weeks | 2E | 1.E -RT and creatine supplements<br>2. E -RT |
| 26. Haub, Wells, Tarnopolsky & Campbell ( 2002) | 21 | 65 ± 5 | M | 15 weeks | 2E | 1E- RT and a vegetarian diet<br>2E-RT and the veal diet |
| 27. Yarasheski, Campbell & Kohrt (1997) | 18 | 64-75 | M | 16 weeks | 2E | 1.E- RT and hormone supplements<br>2.E- RT |
| 28. Campbell, Crim, Young & Evans (1994) | 12 | 56-80 | M/W | 12 weeks | 2E | 1E-RT and a low protein diet<br>2E- RT and a high protein diet |

W-women; M-men; E-experimental group, C-control group; RT-resistance training, ET-endurance training; CT-combined training; NE-no exercise;

The number of participants in the studies ranged from at least 12 as in the research of Campbell et al. (1994), up to 246 at most, as in the research of Kemmler et al. (2010). The participants in the research belonged to a population aged from 55 to 64 and a group of elderly citizens (65-74) and senior elderly citizens (75-84,) according to the classification of the ACSM (2006).

In four of the studies the participants were only males, Delecluse et al. (2004), Haub et al. (2002), Eijnde et al. (2003), Yarasheski et al. (1997). In eight of the studies the participants were only females, Kemmler et al. (2010), Wanderley et al. (2010), Fjeldstad et al. (2009), Kwon et al. (2008), Micheli da Silva et al. (2006), Di Pietro et al. (2006), Barbosa et al. (2001), Sartorio et al. (2004). In the remaining 16 reviewd papers, the sample of participants was mixed in terms of gender. In four of the studies the participants were obese Ballor et al. (1996), Lyndon et al. (1999), Sartorio et al. (2004), Solomon et al. (2008).

The duration of the applied exercise programs in the reviewed studies differed and ranged from at least three weeks Sartorio et al. (2004) to 18 months at the most, Kemmler et al. (2010). In the greatest number of studies, the exercise program lasted for 12 weeks. One study was transversal in character, Lan et al. (1996).

The greatest number of groups recorded in the research was four, that is, three experimental and one control group, Delecluse et al. (2004). Only one experimental group, without a control group, was found in four of the studies Wanderley et al. (2010), Micheli da Silva et al. (2006), Hunter et al. (2000), Poehlman et al. (1991). In five of the studies there was one experimental and one control group Kemmler et al. (2010), Kwon et al. (2008), Barbosa et al. (2001), Jessup et al. (1998), Lan et al. (1996). In four of the studies there were two experimental and one control group Fjeldstad et al. (2009), Thomas et al. ( 2005), Hersey III et al. (1994), Di Pietro et al. (2006). Three experimental groups each were found in two of the studies, Sartorio et al. (2004), Rogers et al. (2006). In the remaining nine studies, there were two experimental groups each.

**Table 2.** A short description of the exercise program, the parameters of body composition which were measured and the results of the analyzed studies.

| Study References | A short description of the experimental program | The measured parameters of body composition | Results |
|---|---|---|---|
| 1. Kemmler et al. (2010) | A:dance aerobics, coordination exercises and isometric and dynamic strength exercises (calisthenics) F: 2 times a week in groups and two times a week at home D: 60 minutes of group exercise and 20 minutes of individual exercise at home I:70-85% Hrmax V: 3 sets of 6-10 seconds and 2-3 sets of 10-15 repetitions | BW, %BF, FFM, AFM | Following the applied program statistically significant changes occurred in all of the cited elements of BC which led to the difference between the experimental and control group. |
| 2. Wanderley et al. (2010) | A: walking F: 3 times a week D:50 minutes I: 50-70%HRR | BW, %BF, FFM, AFM | No statistically significant changes in the elements of BC. |
| 3. Fjeldstad et al. (2009) | A: strength training on an isotonic machine and vibration training F: 3 times a week I: 80%1RM, V: 8 exercises in 3 sets of 10 repetitions | %BF, FM, FFM | In the second experimental group a statistically significant decrease in the %BF took place. In both experimental groups, a statistically significant increase in FFM was determined for the entire body, arms and abdomen. |
| 4. Kwon et al. (2008) | A: strength training with weights and dance aerobics F:3 times a week D:60 minutes I: 40-75%HRR and 75%1RM V: 6 exercises of 3-10 repetitions | MM, %BF | A statistically significant increase took place in the MM of the entire body, arms and legs of the experimental group in relation to the control one. |
| 5. Micheli da Silva et al. (2006) | A: strength exercises on various machines F: 3 times a week I: 10-12 repetitions of 1RM V: 5 exercises of 2 sets with 10-12 repetitions | BW, FM, %BF, FFM | No statistically significant changes occurred in the elements of the BC, except for a small reduction in BW. |

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| 6. Di Pietro et al. (2006) | A: step aerobics, treadmill walking and the rowing ergometer<br>D:45-65 minutes<br>F: 4 times a week<br>I:E1 80%$VO_2$max i E2 65% $VO_2$max i K 50% $VO_2$max | TBM, FFM, %BF | The applied exercise programs did not lead to any statistically significant changes in the elements of the BC. |
| 7. Thomas et al. ( 2005) | A: Tai Chi and strength training<br>F:3 times a week<br>D: 60 and 45 minutes.<br>V: 7 exercises of 30 repetitions | %BF | No differences were noted between the groups at the final measuring, and there were no statistically significant changes in the %BF. |
| 8. Galvao et al. ( 2005) | A: strength training on various machines<br>F: 2 times a week<br>I: 8RM<br>V: 7 exercises of 8 repetitions | FFM, FM, %BF | No statistically significant changes were noted between the groups in terms of the elements of the CB. |
| 9. Delecluse et al. (2004) | A: cycling, walking and strength exercises<br>F: 5 times during 2 weeks<br>D: 36-70 minutes<br>I:60-80 %HRR and E1 20RM-8RM i E2 30RM<br>V: 10 exercises of 2 sets | BW, %BF | The applied exercise programs did not lead to statistically significant changes in the elements of the BC. |
| 10. Barbosa et al. (2001) | A: strength exercises on machines<br>F:3 times a week<br>V:3 series of 6-10 and 10-15 repetitions and 5 series of 6-10 repetitions<br>I: the cited number of repetitions of RM<br>D: 85 minutes | % BF | No statistically significant differences were found in the %BF. |
| 11. Hunter et al. (2000) | A: strength exercises on machines<br>F:3 times a week<br>I: 65-80%1RM<br>V:10 exercises of 2 sets of 10 repetitions<br>D:45 minutes | BW, FM, FFM, %BF | Statistical significant changes were determined in all of the elements of BC. |

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| 12. Lyndon et al. (1999) | A: strength exercises on machines<br>F: 2 times a week<br>I: 80%1RM<br>V: 2 sets of 8 repetitions and 3. set until fatigue or 12 repetitions | BW, % BF, FFM, FM | In the group of men, statistically significant increase in the FFM was determined, as was a decrease in %BF and a decrease in FM. In the group of women, no changes were determined in the cited parameters. |
| 13. Jessup et al. (1998) | A: the treadmill and stair climbing<br>F: 3 times a week<br>D: 60 min.<br>I: 50-80%HRmax | BC | No statistically significant changes in the BC were determined. |
| 14. Ballor et al. (1996) | A: treadmill walking and strength exercises<br>F: 3 times<br>D: progressively from 20 to 60 min.<br>I: 50-80%1RM and 50% VO2max.<br>V: 7 exercises of 3 sets of 8 repetitions | BW, %BF, FFM, FM | In the group involved in aerobic training, a decrease in the BW and FM by 5% was determined. |
| 15. Lan et at. (1996) transversal | A: TCC<br>F: 4.3±1.3 times a week<br>D: approximately 54 minutes<br>I: 70% HRmax | percentage of body fat %BF | The experimental group had a smaller % of body mass in relation to the control group. |
| 16. Hersey III et al. (1994) | A: walking and strength exercises on a machine F: 3 times a week<br>D: 20 progressively up to 45 min.<br>I: 50-75-85% HRR and 8-12 repetitions<br>V: 1 sets of 8-12 repetitions | BW, %BF | Endurance training in the case of the first experimental group led to a statistically significant decrease in %BF. |
| 17. Poehelman et al. (1994) | A: bicycle<br>D: until 150-300 calories have been burned<br>F: 3 times a week<br>I: 60-75 %VO2max | BW, FM, FFM | No statistically significant changes were determined in any of the variables of body composition. |
| 18. Kohrt et al. (1992) | A: walking and running<br>F: 4 times a week<br>D: approximately 46 min<br>I:80%Hrmax | FM, FFM | The exercise program led to a decrease in FM while no changes in the FFM were determined. |

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| 19. Poehlman et al. (1991) | A: bicycle<br>D: until 150-300 have been burned<br>F: 3 times a week<br>I: 60-75 %VO2max | BC | No statistically significant changes in the BC were determined. |
| 20. Iglay et al. (2009) | A: strength exercises on machines<br>F: 3 times a week<br>I: 80% 1RM<br>V: 8 exercises of 2 sets of 8 and 3. set until fatigue | FM, fat free mass FFM | A statistically significant increase in fat-free mass and a decrease in FM was determined for both groups. In addition, a decrease in fat mass in relation to region (hands, legs and the torso) was determined and a decrease in fat-free mass. |
| 21. Solomon et al. (2008) | A: treadmill running, bicycle ergometer, rowing<br>F: 5 times a week<br>D: 60 minutes<br>I:75%VO2max | BW, FM, FFM | A statistically significant decrease in FM was determined without changes in FFM of both groups. The improvements in body composition were more significant in the group with reduced calorie intake. |
| 22. Rogers et al. (2006) | A:strength exercises on machines<br>F:3 times a week<br>I:70%1RM<br>V: 6 exercises of 3 sets of 8 to 12 repetitions | TBM, FFM, FM, %BF | A statistically significant increase in FFM was determined in all three groups, but the greatest increase was determined for the first and second experimental group. The second group showed the greatest signs of decrease in the FM. |
| 23. Sartorio et al. (2004) | A: isotonic machines, treadmill and the bicycle ergometer D:30 min and exercise<br>I: 40-60%VO2max and 40-60%1RM<br>V:15 repetitions | BW, %BF, FFM | In all three groups a statistically significant decrease was determined for %BF and BW, while no changes in the FFM were determined. |
| 24. Eijnde et al. (2003) | A:bicycle ergometer, the treadmill and resistance<br>F: 10 training session over 4 weeks<br>D: approximately 75 minutes<br>I: 65-80%HRR and 30RM<br>V: 7 exercises of 2 sets of 30 repetitions | BW, %BF, FFM | In the case of both groups, statistically significant changes occurred in the variables of body composition. The authors have concluded that the applied supplementation did not lead to significant changes in relation to the second group. |

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| 25. Brose et al. (2003) | A:strength exercises on machines<br>F:3 times a week<br>I:1 set at 50%1RM progressively until 2 sets of 80%1RM<br>V:12 exercises of 10 and 12 repetitions | TBM, FFM | A statistically significant increase was determined for the FFM and TBM in the experimental group which was taking creatine supplements. |
| 26. Haub et al. (2002) | A: strength exercises on machines<br>F:3 times a week<br>I: 1. set 40% 1RM 1. set and the remaining 3 sets 80% 1RM<br>V: 5 exercises, 1. set of 4 repetitions, 2. and 3. set of 8 repetitions and 4. set until fatigue | BW, FM, FFM | No statistically significant changes in the body composition were determined. |
| 27. Yarasheski et al. (1997) | A: strength exercises on machines<br>F: 4 times a week<br>V: 9 exercises of 4 sets of 5-10 repetitions | BW, %BF, FFM | The increase in FFM was equal in both groups. |
| 28. Campbell et al. (1994) | A: strength exercises on machines<br>F:3 times a week<br>I: 80%1RM circumferences: 4 exercises, 1. and 2. series of 8 repetitions and 3. series of 12 repetitions or fatigue | BW, %BF, FM, FFM | FM and %BF decreased in a statistically significant manner, while the FFM increased in a statistically significant manner. |

A-activity; F-frequency; D-duration; I-intensity; V-volume; BC-body composition; BW-body weight; %BF-percent body fat; FM-fat mass; FFM-fat-free mass; MM-muscle mass; TBM-total body mass; AFM-abdominal fat mass;

In eight of the nine studies where the experimental treatment in addition to the exercise program included a diet or using certain diet supplements led to changes in body composition Iglay et al. (2009), Solomon et al. (2008), Rogers et al. (2006), Sartorio et al. (2004), Eijnde et al. (2003), Brose et al. (2003) Yarasheski et al. (1997), Campbell et al. (1994). Only in the research of Haub et al. (2002) did no changes in body composition occur.

At the same time, the most frequent types of training used was resistance training Iglay et al. (2009), Cambell et al. (2002), Cambell et al. (2004), Rogers et al. (2006), Brose et al. (2003), followed by endurance training Eijnde et al. (2003), Solomon et al. (2008) and combined forms of training Sartorio et al. (2004). Depending on the study, changes occurred in the lean body mass, % of body fat and fat body mass.

Nineteen of the studies which included only exercise programs without dieting or supplements made a smaller contribution to the changes in body composition. In nine of the studies from this group, no changes in body composition took place Wanderley et al. (2010), Micheli da Silva et al. (2006), Di Pietro et al. (2006), Galvao et al. ( 2005), Delecluse et al. (2004), Barbosa et al.(2001), Jessup et al. ( 1998), Poehelman et al. (1994), Poehlman et al. (1991).

In the studies in which the experimental treatment included not only the use of an exercise program, but in which endurance training, resistance training and combined training were present in equal amounts. In their study Thomas et al. (2005) determined that there were no differences in the body composition between resistance training and Tai Chi. In two of the studies a comparison of endurance training and resistance training was made, Hersey III et al. (1994), Ballor et al. (1996). In both studies endurance training made significantly greater contribution to the changes in body composition or the decrease in body mass and body weight This is in agreement with the research (Bryner, Ullrich, Saures, Donley, Hornsby et al., 1999) in which evidence was found that aerobic training is far more effective in the decrease of body weight and fat body mass than resistance training.

The results obtained in such a way in the studied research indicate that an appropriate diet and program make the greatest contribution to the positive changes in body composition. This is in agreement with the recommendations of the American College of Sports Medicine, which indicates that the best way of reducing body weight is a combination of exercise and a proper diet (ACSM, 2001; according to Heyward, 2010).

In the studies in which the changes in body composition occurred, the duration of the exercise program was most often a period of 12 weeks. The longest exercise program which led to the changes in body composition lasted for 18 months Kemmler et al. (2010), while the shortest one lasted for 3 weeks Sartorio et al. (2004).

In the studies in which resistance training led to changes in the parameters of body composition, the intensity progressively increased up to 80%1RM. The most common frequency of exercise was three times a week, followed by twice a week, Lyndon et al. (1999) and four times a week Yarasheski et al. (1997). The exercise was mostly performed in three sets Campbell et al. (1994), Rogers et al. (2006), Iglay et al. ( 2009), Lyndon et al. (1999) followed by two and four sets. The most frequent number of repetitions in the series was 8 to 12. Strength exercises were carried out on machines used to develop strength.

When endurance training was used in the studies in which changes took place in the parameters of body composition, the intensity of the exercise was determined on the basis of the percentage of maximum heart rate frequency (%HRmax), the percentage of heart rate reserve (%HRR) and of maximal oxygen uptake (%VO2max). When using %HRmax the intensity most often ranged from 70 to 80 %HRmax. When using %HRR the intensity ranged from 40-75, 50-75 and 65-80 %HRR. When using %VO2max the intensity of the exercise was 50, 40-60 and 75 %VO2max. On the basis of this we can conclude that moderate to high intensity exercise was used. The frequency of the exercise was most often three times a week Hersey III et al. (1994), Ballor et al. (1996), Kwon et al. (2008), followed by two and four times a week. The duration of each training session was approximately 60 minutes. Of the aerobic activities, the treadmill walk and running, cycling (the bicycle ergometer) and dance aerobics were used the most frequently.

## 3. CONCLUSION

An analysis of the methods, experimental treatment, results and the conclusions which the authors reached in their studies enabled us to reach a conclusion regarding certain rules of the effects of the exercise program on body composition in the case of individuals aged 55 to 85.

The greatest positive effects on the changes in body composition in the cited group of participants were determined for exercise programs in combination with a suitable diet. If the aim of the exercise program is the decrease in body weight and body mass, it is necessary to include endurance training. If the aim of the exercise program was to increase fat-free mass it is necessary to perform suitable resistance training.

On the basis of the results of the analyzed studies, the optimal duration of the exercise program should is at least 12 weeks, with a frequency of 3 or 4 times a week. The intensity of the exercise in the case of resistance training should increase progressively up to 80%1RM. Each exercise should be performed in three sets of 8 to 12 repetitions. In the case of endurance training, the intensity of the exercise should be at least 80%Hrmax or in other words, the intensity of the exercise should be moderate to high, with an average duration of 60 minutes. In addition, combined training also had a positive influence on the changes in body composition.

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# EFEKTI FIZIČKOG VEŽBANJA NA TELESNU KOMPOZICIJU KOD STARIH OSOBA: PREGLEDNI RAD

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*Telesna kompozicija je jedan od komponenti fizikog fitnesa i odnosi se na komponente tkiva koja čine telo i obično se koristi da označi relativni procenat masti i bezmasnog tkiva. U okruženjima zdravlja i fitnesa glavni interes je saznanje o relativnoj količini telesne masti u odnosu na nemasno telesno tkivo i distribuciju masti u organizmu, sa dodatnim interesom za promene u tim komponentama. Fizička neaktivnost je jedan od glavnih uzroka povećanja telesnih masti. Kod starih osoba povećanje telesnih masti je uslovljeno sporijom brzinom hodanja i funkcionalnim limitacijama. Problem ovog rada su istraživanja objavljena u periodu od 1991. do 2010. godine u kojima su proučavani efekti fizičkog vežbanja na telesnu kompoziciju kod osoba starosti od 55 do 85 godina. Cilj rada je analizirati metode, ekserimentalni tretman, rezultate i zaključke do kojih su došli autori u pregledanim istraživanjima. Istraživanje je obuhvatilo 28 radova. Rezultati analiziranih istraživanja pokazuju da najveće pozitivne efekte na promene u telesnoj kompoziciji imaju programi vežbanja u kombinaciji sa odgovarajućom dijetom. Na osnovu rezultata analiziranih istraživanja optimalno trajanje programa vežbanja bi trebalo da bude najmanje 12 nedelja sa učestalošću od 3 ili 4 puta nedeljno. Intezitet vežbanja kod treninga sa otporom bi trebao progresivno da se povećava do 80%1RM. Svaku vežbu bi trebalo izvoditi u tri seta sa 8 do 12 ponavljanja. Kod treninga izdržljivosti intezitet vežbanja bi trebao najviše da bude do 80%Hrmax odnosno da intezitet vežbanja bude umereni do jaki, sa prosečnim trajanjem treninga od 60 minuta.*

Ključne reči: *telesna komozicija, programi vežbanja, efekti, stariji ljudi.*