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Review article

THE EFFECTS OF PHYSICAL ACTIVITY ON THE BALANCE OF THE ELDERLY

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Abstract. *Daily physical activity (PA) is necessary for good quality of life among the elderly. It usually happens that with the advent of years, the extent of exercise decreases among the elderly, which could have negative effects on their health. It is very important to point out that if the health results allow it, it is never too late to begin with programmed training and physical exercise. If it is carried out under supervision, the possibility of injury is significantly reduced. The subject matter of this research are studies published from 2000 to 2016, which focused on the effects of PA on the balance of individuals over the age of 60. The aim of this review is the compilation of the appropriate literature on PA, as well as the clarification on whether there are effects of the PA on the balance of the elderly. This overview included 24 research papers. The results of this study confirm the positive effect of PA on the balance of the elderly. It has been proven that several weeks of a standardized exercise program, based on the increase in joint mobility, cardio-vascular exercise, strengthening the stability of the pelvic region, and proprioceptive exercise can improve balance skills and reduce the perception of pain. For elderly individuals with specific risk factors for falls, the recommendation is specific aquatic exercise programs which will improve balance and strengthen the lower extremities.*

Key words: *Physical activity, effects, balance, aquatic program, the elderly, balance tests*

INTRODUCTION

The duration of one's life and its quality, in addition to the genetic characteristics of an individual's life, to a great extent also depend on one's lifestyle, behavior in terms of maintaining one's health and health-related attitudes, their socio-social status and our

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environment (phenotype). Aging is an individual process and we can define it as the period of decay of the structures and function of the human body (Buneta & Didović, 2016). If elderly individuals do not take part in physical exercise, they expose themselves to risk of having their muscle mass and joint motion reduced (Kostić, Uzunović, Pantelić, & Đurašković, 2009). Postural control is reduced with age and the states of various systems decrease. This could lead to abnormality of movement and postural instability (Barauna et al., 2004; Tainaka, Takizawa, Katamoto, & Aoki, 2009). Postural instability can affect one's functional ability to perform activities of daily living, which leads to a decrease and limit to our range of movement (Perracine & Ramos, 2002; Aslan, Cavlak, Yagci, & Akdag, 2008). Daily physical activity (PA) is necessary for the good quality of life of the elderly. It usually happens that over the years the elderly experience a decrease in the extent of their exercise, which could have a negative impact on their health. All existing research has confirmed that exercise is very important for individuals over the age of 50, if they would like to maintain their vitality and freshness, preserve muscle power, coordination and balance (Dohrn, Hagströmer, Hellénius, & Ståhle, 2017).Age cannot be an excuse for the lack of PA. Programmed and professionally designed exercise for elderly women or men makes it possible to adjust the program during the initial month of training so that it is suited to their current state of health, so that the elderly can realize just how healthy exercise is and how necessary for the locomotor apparatus and body as a whole during a pleasurable and light training session (Lebar Bašić, Zorić, Čutura, Grizelj, & Krstičević, 2016). Of course, every type of exercise will result in an improvement in mood. The elderly should be physically active because it is the only way for them to remain vital. We should not forget that high quality health status to a great extent depends on the muscle status, and not only the work of the heart or lungs. This means that in addition to movement, it is also necessary to activate larger groups of muscles individually (Rubenstein et al. 2000; Gauchard, Gangloff, Jeandel, & Perrin, 2003).The loss of muscle power and muscle mass are one of the reasons for the onset of illness among the elderly. Men and women lose muscle mass over the years, and thus the muscles become slower and more susceptible to injury. It is very important to point out that if one'shealth allows it, it is never too late to begin with programmed training sessions and physical exercise. Under the appropriate supervision, the risk of injury is significantly smaller. The subject matter of this research are studies published from 2000 to 2016, which focused on the effects of PA on the balance of individuals over the age of 60.

The aim of this review is to compile the appropriate literature on PA, and to clarify whether PA has any effects on the balance of the elderly.

The following tasks were completed: The existing databases were searched; An overview and translation of the compiled literature was provided; and The research results were analyzed.

THEORETICAL CONSIDERATIONS OF THE PROBLEM

The following electronic databases were searched: PubMed, SCIndex, and Google Scholar journals from the field of Sports Science, as well as the relevant literature which could provide an answer the set problem. SCIndex papers published from 1999 to 2017 were reviewed. The search was carried out based on a combination of key words: PA, effects, balance, aquatic program, the elderly, tests of balance. The descriptive method was used to analyze the obtained data. The systematic review of the papers was carried out following the methodological guidelines, and in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) consensus (Moher, Liberati, Tetzlaff, & Altman, 2009).

The criteria for inclusion

Type of study:

Controlled randomized and non-randomized studies were reviewed and included in the further analysis, as were papers which were published in English.

The sample of participants:

The participants included in the study were women and men over the age of 60, irrespective of their lifestyle, Body Mass Index (BMI) and health status.

Type of intervention:

Studies were included if the results determined the existence of effects of PA;

The type of obtained results:

Studies were included if they presented the influence of PA on balance following training.

Criteria for exclusion

Type of study: 1) studies written in a language other than English and Serbian; 2) studies which did not include a control group or did not include experimental groups; 3) duplicate studies; 4) studies which included participants under the age of 60.

RESULTS

Following a general search of the database, we identified 650 potential papers and another 25 additional ones based on their list of references. After deleting duplicate studies and eliminating papers based on their titles and abstracts, we were left with 72 studies. The remaining papers were reviewed in detail. Based on the criteria for inclusion, another 48 papers did not satisfy the criteria for further analysis, while 24 studies did meet the predefined criteria and were included in the systematic review. A detailed overview of the selection of papers and their process of inclusion can be found in Figure 1.

The overall number of participants included in this review was 1017, 179 of whom were males, 302 were females, while in the case of 536 participants, the numbers of men and women included in the study were not provided. Thirteen studies (Carmeli, Kessel, Coleman, & Ayalon, 2002; Kawanabe et al., 2007; Woo, Hong, Lau, & Lynn, 2007; Tuna, Edeer, Malkoc, & Aksakoglu, 2009; Appell, Pérez, Nascimento, & Coriolano, 2012; Paquette, Li, Hoekstra, & Bravo, 2015; Mateos et al., 2014; Ema et al, 2016; Lebar Bašić et al., 2016; Perrin, Gauchard, Perrot, & Jeandel, 2016; Sinaei, Kamali, Nematollahi, & Etminan, 2017; Dohrn et al., 2017; Patti et al., 2017) included both male and female participants, five studies (Rubenstein et al., 2000; Sarvestani, Tabrizi, Abbasi, & Rahmanpourmoghaddam, 2012; Dehkordi, Sokhangoei, Y., & Azarbayjani, 2012; Khanjari & Ameri, 2015; Iwakura et al., 2016) included male participants and six studies (Gauchard et al., 2003; Madureira et al., 2007; Daniel, Vale, Giani, Bacellar, & Dantas, 2010; Maitre, Symoneaux, & Sulmont-Rossé, 2013; de Souza Moreira et al, 2016; Neira, Marques, Pérez, Cervantes, & Costa, 2017) only female participants.

The most common duration of the training program (in 6 studies) was 12 weeks (Rubenstein et al., 2000; Daniel et al., 2010; Mateos et al., 2014; de Souza Moreira et al., 2016; Dohrn et al., 2017; Neira et al., 2017), then 8 weeks (5 studies) (Kawanabe et al., 2007; Dehkordi et al., 2012; Paquette et al., 2014; Khanjari & Ameri, 2015; Ema et al., 2016), one day in four studies (Tuna et al., 2009; Iwakura et al. 2016; Maitre et al., 2015; Perrin et al., 1999), 48 weeks in two studies (Madureira et al., 2007; Woo et al., 2007), 10 weeks in two studies (Coriolano Appell et al. 2012; Sarvestanil et al. 2012), 4 weeks in two studies (Lebar Bašić et al. 2016; Sinaei et al., 2017), 25 weeks in one study (Carmeli et al., 2002), and 13 weeks in one study (Patti et al., 2017).

The most frequently used test of balance was standing on one leg, a static posturographic test on a vertical force platform (Toennies GmbH Freiburg Germany), a training program for balance improvement, the Romberg test and the Up & Go test. The frequency of the training sessions was at most 3 (10 of the 24 studies) and 2 times a week (6 studies out of 24). The most frequent duration of the training sessions was 60 minutes, followed by 45, 30, 50 and 90 min, while the training sessions on a treadmill lasted for 10-15 minutes, at moderate intensity.

Discussion

Balance disorders significantly increase with age due to the decrease in the quality of balance control, which increases the risk factors for falls. Contrary to that, it has been proven that PA improves the quality of postural control among the elderly and decreases the number of falls (Gauchard et al., 2003).

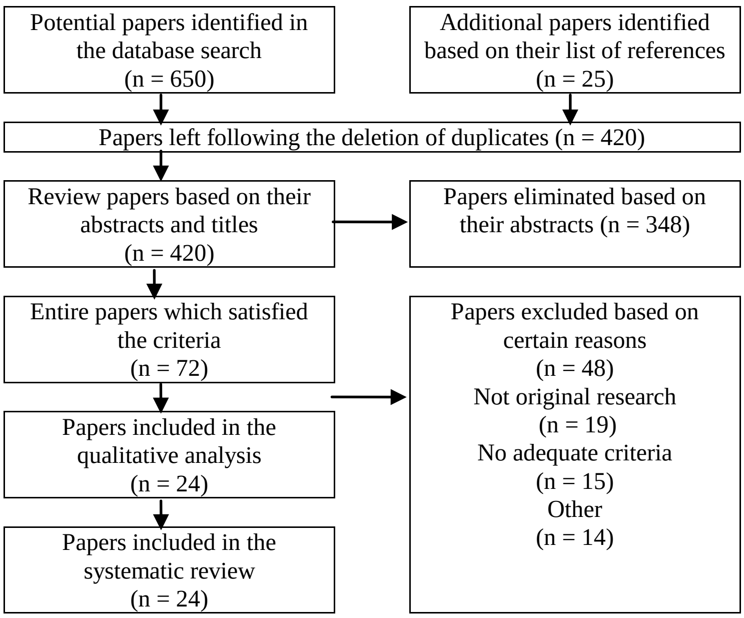

Fig. 1 An overview of the process of selecting adequate papers based on the predefined criteria

Table 1 A systematic review and characteristics of the included studies

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Perrin et al. (1999)	Healthy active	M/F	X	71.8	65	M (n=22) F (n=43)	I-AA-daily, whole life II-NA-daily, second half of life III-AN-daily, first half of life IV-NN- inactive	moderate	60	Physical and sports activity	3 posturo-graphic tests (static, quick, dynamic, slow sinusoidal dynamic) The balance platform (Tonis Gmbh, Freinburg, Germany)	The best results for the ability to maintain balance for all three tests rank the groups in the following order AA>NA>AN >NN
Rubenstein et al. (2000)	Specific risk factors for falls	M	X	74	59	EG=31 CG=28	3/12	Low moderate	90	Strength training, endurance and balance	POMI test	Increase in isokinetic endurance and walking endurance (10% better), number of falls reduced almost three timesin the EG
Carmeli et al. (2002)	Down syndrome	M/F	X	63	26	WG (n=16; M=6/F=10) CG (n=10; M=4/F=6)	3/25	moderate	45 10-15 treadmill	Walking on a treadmill	Up & Go test	Significant improvement in isokinetic power of the legsas well as dynamic balance

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Gauchard et al. (2003)	Healthy active	F	X	EG1-74 EG2-71 CG-75	44	EG1=15 EG2=12 CG=17	EG1-1/ week EG2-2/week running 1-2/week swimming 25km/week cycling	moderate	EG1-90	EG1=8-PPA yoga 13-soft gymnastics EG2=9-running 10-swimming 4-cycling CG= walking	Static posturo-graphic test on a vertical force platform (Toennies GmbH Freiburg Germany) with 4 pressure gauges	EG1 achieved the best results in improved balance and precision
Madureira et al. (2007)	Osteoporo sis	F	X	74	66	EG=34 CG=32	EG=1/week/12m onths CG=3/week at home	Moderate	60	Balance exercises described byTinetti and Suzuki	Balance training program BBS STSIB TUGT	Initially-no differences between the groups Finally- a statistically significant difference between the groups in terms of functional and static balance, mobility and the number of injuries during a fall

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Kawanabe et al. (2007)	Post-menopausal women	M/F	X	WBV= 71.8±0.9 RE=71.3 ±1.4	67	WBV (M=1/F=39) RE (M=3/F=24)	1/8	12-20 hz	4	WBV= Galileo machine Fitnesstraining	Standing on one leg Walking 10 min	The results are significantly better for the group which practiced on the Galileo machine
Woo et al. (2007)	Healthy	M/F	TC (M=23.56 ±3.4/ F=24.40 ±4.3) RTE (M=24.10 ±3.4/ F=24.60 ±4.0) CG (M=23.80 ±3.1/ F=24.93± 3.0)	65-74	180	TC (M=30/F=30) RTE (M=30/F=30) CG (M=30/F=30)	TC=3/week/12months	Moderate	X	Tai Chi, still Jang with 24 forms Resistance training	Smart balance master Measuring power on a dynamometer and measuring mineral bone density using Dual X ray densitometry	Apart from a decrease in the loss of bone density among women, there was no improvement in balance, flexibility or the number of falls

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Tuna et al. (2009)	No chronic illnesses 22(9.6%) With one 43(18.8%) With two 64(27.9%) With three 48(21%)	M/F	27.8±4.5	65-68 Younger seniors 65-69 Older seniors ≥70	229	M=118 F=111	One-day testing	Moderate	X	Sitting up from a chair for 30s Agility - 8-foot up and go Aerobic endurance Walking for 6 min	Agility test and dynamic balance: 8-foot up and gotest	Younger seniors have significantly weaker BMI, but their parameters for lower body strength were significantly better, as was their dynamic balance and aerobic endurance, than among the older seniors
Daniel et al. (2010)	Healthy inactive for the last 6 months	F	EG=26.7 CG=27.3	EG=66.46 ±4.35 CG=64.58 ±3.40	49	EG (n=30) CG (n=19)	2/12	Average	60	Physical fitness GDLAM test, measured with a chronometer, repeated twice	Electronicbaro podometer	A statistical improvement the in static balance and physical fitnessof the EG

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Appel et al. (2012)	Healthy individuals without injury and no surgery in the last year	M/F	EG=25.5 ±1.3 CG=25.5 ±1.2	EG=69.6 ±3.1 CG=69.7 ±2.9	39	EG (n=19;M=9/ F=10) CG (n=20;M=10/ F=10)	2/10	Low Cg:≤60%	60	EG:lying, standing position, Pilates program CG:flexibility, strength, aerobic exercise of low intensity, short sports games	Initial and final for both groups,the GGT test	PG:4.32±1.29-5.47±0.96 KG:4.20±1.24-4.25±1.24
Sarvestani et al. (2012)	Healthy inactive elderly men	M	Obese >27-30	ABT: 59.44±2.21 FT: 56.34±4.35 CG: 58.29±3.19	40	ABT (n=13) FT (n=14) CG (n=13)	3/10	Moderate	60	Aquatic balance training Functional training	Y-balance test	Both EG showed positive changes as a result of the applied training with the recommendation forABT for greater safety of the elderly

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Dehkordi et al. (2012)	Healthy	M	X	60-70	30	EG (n= 15) CG (n=15)	8 weeks 24 training sessions	Moderate	45-60	EG: aquatic program	Staticbalance Romberg test Dynamic balance T.G.U.G. test	The aquatic program provided a positive effect on the improvement of balance and the prevention of possible injury and harmful effects due to the work environment
Mateos at al. (2014)	Healthy	M/F	EG:24.64 ±2.97 CG:25.4 ±4.49	EG:79.35 ±7.42 CG:77 ±6.9	44	EG (n=20) CG (n=24)	2/12	Moderate	50	Proprioceptiv e training with a Swiss ball and Bosu ball	Berg balancescale Tinetti test	A significant improvement in flexibility, balance and lumbar strength.No significant improvement in hip joint mobility and static balance

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Maitre et al. (2015)	Healthy EG: active CG: sedentary	F	X	M=20 S=74	68	EG (n=34;M=17/ S=17) CG (n=34;M=17/ S=17)	EG:M=3/S=1 CG:M=1	M: high S: hard moderate	EG (M=3h and more/ S=3h and more) CG (M= less than 2h)	EG:M: swimming, gymnastics, handball, basketball, athletics S:gymnastics, walking, dancing, water aerobics CG:M: college activities S: daily activities	Static posturographic test on a vertical force platform (Toennies GmbH Freiburg Germany) with 4 pressure gauges	Aging diminishes the effectiveness of postural control, but with the application of sports activities it is possible tomake up for the negative effects on the proprioceptiv e abilities through the improved use of sensory information

Study	Population						Training program					
	Health status	Sex	BMI (kg/m²)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Paquette et al. (2015)	Capable of submaximal activity	M/F	±4,5	G70,2±6		EG (n=12) CG (n=13)	2/8	Moderate	30	Testing the reaction speed of the legs, static balance, balance safety	Quick board platform	No significant improvement for the EG for the reaction time of the feet, an improvement of speed of the feet for both groupswith better results for the EG, a difference in the performance of static balance has not been found
Khanjari & Ameri (2015)	X	M	obese	62	15	X	3/8	40-60% HRmax	50-70	Pool exercises	The Sharpened Romberg test TUG test	A positive influence of the program on the increase of balance, the quality and speed of walking

Study	Population						Training program					
	Health status	Sex	BMI (kg/m²)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Ema et al. (2016)	Healthy	M/F	M:23.3 ±2.5 F:22.4 ±2.6	M:73±5 F:71±3	78	M=43 F=35	8	At the level of daily activity	X	Low intensity recreation	Balance test: Standing on one leg eyes open (30s) Strength test: isometric flexion of the feet	A statistically significant connection between maximalvoluntary plantar flexion and the ability to balance among older men while the same was not confirmed among the women
Iwakura et al. (2016)	EG:COPD CG: healthy	M	EG:22.1 ±2.9 CG:22.7 ±2.5	EG:71.6 ±6.9 CG:71.5 ±5.6	35	EG (n=22) CG (n=13)	Evaluation of one-day activity	Low	X	Regular daily activities	Standing on one leg test (olst) Speed walking 4m 5 chair stand ups, a short battery of tests of physical performance	EG COPD group indicated a shorter time on the olst, slower time on 4mgs and the 5stst, which means fewer points on the sppb

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Lebar Bašić et al. (2016)	Chronic musculo-skeletal disease	M/F	X	71±6	53	M(n=12) F(n=41)	5/4	Low moderate	30	Walking, exercises with elastic bands and medicine balls	Timed Up & Go test Four-stage test	Improvements which were not statistically significant were noted
de Souza Moreira et al. (2016)	Physically active	F	X	69.31±7.35	35	EG (n= 14) CG (n=21)	2/12	Moderate	50	Circuit training for balance	Balance test on a platform, eyes closed 30s	EG achieved better results at the final measurement for muscle power and balance force and functional capacity
Sinaei et al. (2017)	Healthy	M/F	STBT: 26.62± 5.05 DTBT: 27.24 ±4.45	64±5	24	M (n=8) F (n=16)	¾	Moderate	45	Both groups, balance training program Second group, cognitive exercises	FAB SF-36 Romberg test	A significant improvement in balance for both groups without significant differences in any of the variables between groups

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Dohrn et al. (2017)	Osteoporosis	M/F	EG:24.5 ±4 CG: 25.4±4.2	75.6±5.4	91	EG1 (n=29) EG2 (n=32) CG (n=30)	3/12	Moderate	45	PA with a pedometer and accelerometer	Standing on one leg	Positive results obtained following a 12-week balance training program on the increase of regular FA were not confirmed at the measurements after 9 and 12 months after the completed program
Neira et al. (2017)	Fibromyalgia	F	obese	35-64	40	EG1 (n=20) EG2 (n=20)	3/12	Moderate	60	Aquatic program Proprioceptive training	Romberg test TUG test EVA test	There is no difference in the balance and pain for the participants of both groups

Study	Population						Training program					
	Health status	Sex	BMI (kg/m^2)	Age	Sample size	Group comparison (*n*)	Frequency/ Duration (days/weeks)	Intensity	Duration (min)	Type of activity	Balance test	Results
Patti et al. (2017)	Healthy	M/F	EG:34.33 CG:30.49	68.07 EG 67.32 ±6.39 CG 68.93 ±2.51	92	EG (n=49; M=23/F=26) CG (n=43; M=19/F=24)	2/13	Moderate	70	Joint movement exercises, cardio exercises, proprioceptive exercises, coordination-eyes-arms, eyes-legs	BBS ODI	An improvement in the balance skills and decrease in the perception of pain for the EG

Legend: M-Male; F-Female; EG-Experimental Group; CG-Control Group; WG-Walkin Group; PSA-Physical and Sporting Activities; PA-Physical Activity; COPD-Chronic Obstructive Pulmonary Disease; HRmax- Maximum Heart Rate; TC-Tai Chi; RTE-Resistance Training Exercise; WBV-Whole Body Vibration; RE-Routine Exercise

Influence based on gender

Ema et al. (2016) tried to determine the relations between the power of the foot flexors and body balance on a mixed sample of participants. Due to the assumption that these two elements are of critical significance for avoiding falls, the strength of the foot flexors was measured with a dynamometer, equipped with a torque transducer (TD200, Cubota Corporation Japan). The used balance test was standing on one leg with eyes open, on a platform, for 30 s. The thickness of the triceps was measured by ultrasonography, with a 60 mm linear probe. After measuring the power of the plantar flexors and body balance, the participants were subjected to eight weeks of treatment for the evaluation of routine daily activities, with the obligatory use of a tri-axial accelerometer. The study shows that there is a statistically significant connection between maximal voluntary plantar flexion and the balancing ability among elderly men, while this has not been confirmed for elderly women. Sinaei et al. (2017), after four weeks of training, obtained a statistically significant improvement in the performance of balance and some factors of quality of life for both groups. There was no statistically significant difference in any of the variables between the groups.

Influence based on lifestyle

Changes which contribute to the decrease in the balance of the elderly are the lack of PA, as the main factor, and then the lifestyle of individuals. The maintenance and increase in muscle power, endurance and dynamic balance are important elements for quality of life and functional independence of the elderly. Gauchard et al. (2003) analyzed the influence of proprioceptive physical activities (yoga and soft gymnastics) and bioenergy PA (running, swimming and cycling) on the afferent visual pathway and the various parameters for the regulation of static balance., An evaluation of static balance and the afferent visual pathway was carried out on a healthy active population with an average age of 74, using a static posturo-graphic test on a vertical force platform fitted with4 pressure gauges. The conclusion is that proprioceptive exercise had the best effect on the regulation of balance and precision. Bioenergetic activity improves postural control only for the simpler postural tasks, while for more difficult tasks, it does not, which points to the smaller development of the neuro-sensitive proprioceptive input threshold for this type of activity, probably due to the greater contribution of the afferent visual pathway. Appel et al. (2012), during a ten-week experimental treatment in which two groups of participants took part, attempted to determine a method for the improvement of balance among the elderly. The aim of the research was to evaluate a Pilates program of body balance (the first group) under supervision, with the use of non-specific physical activities (the second group). The completed tests included tests of balance, prior and after the experiment, for all the participants. The research results indicate that for the group of participants belonging to the second group (control group) no improvement in balance occurred, while the first group, which took part in a Pilates program twice a week over a period of ten weeks, achieved a significantly better improvement in the ability to maintain body balance. By using a circuit training for balance, de Souza Moreira et al. (2016) attempted to prove that this type of exercise has a positive effect on physical functionality, autonomy and health. The experimental treatment lasted for a period of 12 weeks, with two training sessions a week for a duration of 50 min. The circuit training for balance included 10 min. of warm-up and stretching, 30 min of active exercise in pairs with modifications which increase the level of difficulty every three weeks, and 10 min of cool down. The research results indicate that the members of the experimental group improved their muscle power and force, balance and functional capacities. This study shows a positive influence on the use of this program on the improvement of socialization, functional abilities and the easier performance of daily activities. That there is a connection between balance instability, which increases with aging, and participation in physical and sports activities during one's life, is the conclusion reached by the Perrin et al. (1999). Individuals who took part in physical and sporting activities (PSA) when they were young scored worse results than individuals who started taking part in PSA in their later years. This result supports the theory that taking part in PSA reduces the risk of falls and injury among the elderly, which at that age could have catastrophic consequences. The authors concluded that regular PA programs could contribute to the improvement and maintenance of postural control and the performance of daily activities (Daniel, 2010; Maitre et al., 2015). That aquatic balance training (ABT) and physical fitness are effective in the improvement of dynamic balance of inactive elderly individuals was concluded by Sarvestani et al. (2012), who recommended ABT due to greater safety from injury (Dehkordi et al. 2012; Khanjari & Ameri, 2015). By using a standardized program of physical exercise on the floor, with the aim of improving joint mobility and strengthening the lumbar region and the lower extremities, the authors of the program achieved better improvement of balance skills and perception of pain among the members of the EG. Confirmation of the results was evaluated using the Berg Balance Scale (BBS) and Oswestry Disability Index (ODI). This study shows that a standardized thirteen-week exercise program, based on the increase in joint mobility, cardiovascular exercise, strengthening the stability of the pelvic region and proprioceptive exercise can improve balance skills and decrease in the perception of pain (Patti et al., 2017).

Influence based on health status

The effects of an exercise program of low moderate intensity, focused on the increase in power, endurance, mobility and a decrease in the falls among elderly men with specific risk factors for falls (weakness of the legs, impaired movement or balance, previous falls, etc.) is the subject matter of the study carried out by Rubenstein et al. (2000). A group of men, average age 74 were included in an exercise program for a duration of 90 min, three times a week, with the aim of increasing power and endurance and improvement of mobility and balance. The experimental group showed a significant improvement in the domain of endurance and mobility and significantly fewer falls (6 to 16.2) compared to the control group. These findings indicate the positive influence of exercise on power, endurance, mobility and balance, as well as a decrease in the rate of falls through an adjustable level of PA. For individuals with chronic musculoskeletal conditions, Lebar Bašić et al. (2016) used the Four-Stage Balance and Timed Up & Go tests to evaluate static and dynamic balance at the beginning and end of a four-week program, for a duration of 5 days for30 min a week. After physio-therapy group exercises with an emphasis on balance exercises, we obtained positive results regarding an improvement of balance and decreased number of falls, but without statistical significance. The recommendation of the authors is a longer program with an addition of activities which provided positive results (Tai Chi, aquatic, etc.). Testing the power of the legs using a dynamometer and the Up & Go functional test, also tested the power and dynamic balance of older (63 years) mentally challenged individuals with Down syndrome. The same process was repeated after a six-month exercise program with a dynamic of three-times a week for a duration of 10-15 min at the beginning of the program, to at most 45 min. at the end of the program. The results indicate a significant increase in the isokinetic power of the flexors and extensors of the knee joint and a significant improvement in dynamic balance. That a program based on walking on a treadmill can contribute to the improvement of quality of life and ensure the functional motor independence of the elderly with Down syndrome is the conclusion of the authors who carried out these experimental studies (Carmeli et al., 2002). The longitudinal study of Madureira et al. (2007) showed that a balance training program is effective for the improvement of functional and static balance, mobility and frequency of falls among elderly women with osteoporosis (Dohrn et al., 2017). Iwakura et al. (2016), dealt with the relation between balance and PA among the elderly with chronic COPD. A sample of 22 participants with COPD and 13 healthy participants (control group), average age 72±6.5 was included in an evaluation of the status of balance using a battery of tests. The analysis of the difference between the groups indicated that the differences, indicated by the tests of PA, are large and statistically significant, while the tests for the evaluation of balance showed minimal differences which were not statistically significant. The conclusion is that the deficit in balance is independently connected to the physical inactivity. The authors of this study attempted to determine the effects of age and the level of PA on some functional fitness parameters, among the population of the elderly. The evaluation of functional fitness included BMI, lower body strength, dynamic balance and aerobic endurance. The research results indicate that younger senior citizens have a significantly lower level of BMI, but their parameters of lower body strength, dynamic balance and aerobic endurance are significantly better than those of older seniors. The experiment showed that PA among younger senior citizens influences the status of BMI, while this was not the case among older senior citizens (Tuna et al., 2009).

CONCLUSION

Based on the obtained results, we can conclude that the results of the current research confirm the positive effect of physical activities on balance among the elderly. It has been proven that a standardized program consisting of several weeks of exercise based on the increase of joint mobility, cardiovascular exercise, strengthening the stability of the pelvic region and proprioceptive exercise can improve balance skills and reduce the perception of pain. Studies prove that a continued and long-term training program is the only way to achieve a higher level of physical functions, performance of balance, and speed of walking, and that generally a higher quality of life can be achieved for longer periods of time. For the elderly with specific risk factors for falls, the recommendation is that they participate in aquatic programs which include exercises for the improvement of balance and for strengthening of the lower extremities.

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EFEKTI FIZIČKE AKTIVNOSTI NA RAVNOTEŽU STARIH OSOBA

Svakodnevna fizička aktivnost je neophodna za kvalitetan način života kod starijih osoba. Obično se dešava da se sa godinama kod starijih ljudi smanjuje obim vežbanja a to može imati negativne posledice po njihovo zdravlje. Vrlo je bitno da se naglasi da ako zdravstveni rezultati omogućavaju nikada nije kasno da se kerne sa programiranim treninzima i fizičkim vežbanjem. Uz nadzor, mogućnost od povrede je dosta manja. Predmet istraživanja predstavljaju studije publikovane u periodu od 2000 do 2016, fokusirane na efekte fizičke aktivnosti na ravnotežu osoba starijih od 60 godina. Cilj ovod pregleda je prikulljanje odgovarajuće literature o fizičkoj aktivnosti, kao i da pojasni da li postoje efekti fizičke aktivnosti na ravnotežu starih osoba. U sistemastkom pregledu uključeno je 24 istraživanja. Rezultati ove studije potvrđuju pozitivan efekat fizičkih aktivnosti na ravnotežu kod starih osoba. Dokazano je da standardizovan program višenedeljnog vežbanja, baziran na povećanju mobilnosti zglobova, kardiovaskularnom vežbanju, jačanju stabilnosti karličnog pojasa i proprioceptivnog vežbanja može poboljštai balansne veštine i smanjiti percepciju bola. Za starije osobe sa specifičnim faktorom rizika od pada, preporuka je vežbanje u bazenima uz program vežbi za poboljšanje ravnoteže i jačanje donjih ekstremiteta.

Ključne reči: *fizička aktivnost, efekti, balans, aquatic program, stare osobe, balans testovi*