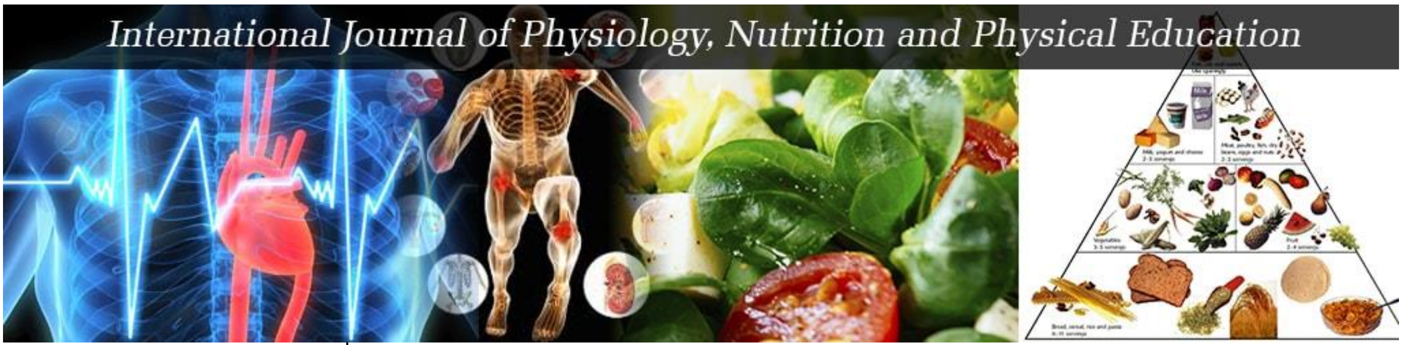

ISSN: 2456-0057
IJPNPE 2022; 7(2): 277-281

www.journalofsports.com
Received: 15-06-2022
Accepted: 19-07-2022

Dr. PK Senthilkumar
Associate Professor, Head, Department of Exercises Physiology and Biomechanics, TNPESU, Chennai, Tamil Nadu, India

Corresponding Author:
Dr. PK Senthilkumar
Associate Professor, Head, Department of Exercises Physiology and Biomechanics, TNPESU, Chennai, Tamil Nadu, India

Efficacy of neuromotor and functional training on musculoskeletal fitness among middle aged women

Dr. PK Senthilkumar

DOI: https://doi.org/10.22271/journalofsport.2022.v7.i2e.2625

Abstract
The aim of this study was to determine the Efficacy of Neuromotor and Functional training on musculoskeletal fitness among middle aged women. To achieve the purpose of the study thirty six middle aged women were randomly selected as subjects and their age ranged between 45 to 50 years. They were divided into three groups. Group I acted as Neuromotor training group (n=12), Group II acted as Functional training (n=12) and Group III acted as control group (n=12). The experimental groups participated in the respective training programme for a period of ten weeks. The subjects of the control group participated on their routine activities. To assess Muscular strength was assessed via a one repetition maximum (1-RM) bench press and squat test. Muscular endurance was evaluated using a curl-up test. Flexibility was assessed using a modified sit-and-reach test and the best of three results was recorded to the nearest 0.1 cm as the final value. Results indicated significant ($p< 0.05$) increases in muscular strength (1-RM bench press, 1-RM squat), muscular endurance (curl-up) and increases in flexibility (sit-and-reach) within each group following training. It was concluded that both training programs are equally beneficial for increasing musculoskeletal fitness in middle aged women.

Keywords: Neuromotor and functional training, muscular strength, muscular, endurance and flexibility

Introduction
Aging is a multifactorial, progressive, and irreversible process that involves structural and functional variations characterized by loss of adaptive capacity, increased susceptibility to chronic non-communicable diseases, musculoskeletal and metabolic disorders, loss of functionality and quality of life. The decline in functional capacity can be partially explained by the loss of efficiency of neuromuscular, cardiorespiratory and somatosensory systems, induced by the aging process associated with reduced level of habitual physical activity (Garatachea, *et al*., 2015) [8].

Physical activity (PA) is considered as one of the most important health indicators yielding benefits for all the major groups of age, especially older adults. In such age group people, the benefits could be related to the improvement in physical fitness and the prevention of functional loss (Henwood and Taaffe, 2006) [9]. The American College of Sports Medicine (2009) recommends, as part of a guiding on basic exercises, that the elderly should use exercise programs focused on four physical fitness components (cardiorespiratory endurance, muscle strength, flexibility and neuromotor fitness).

Neuromotor training is a relatively new component of fitness officially identified by the American College of Sports Medicine in their 2011 position stand (Garber *et al*. 2011) [9] as well as in the 2014 Guidelines (ACSM 2014) [3]. Neuromotor training involves training skills such as balance, coordination, gait, agility, and proprioception. It is important for everyone but has been shown to be especially important for older adults as an effective way to decrease the risk of falls (Bird *et al*. 2010; Nelson *et al*. 2007) [4, 15].

Neuromotor training focuses on body stability and maintaining an equilibrium while in a still or moving position (i.e. balance, coordination, reflexes). It also provides a foundation for building postural support, physical function, and preventing falls ("functional fitness"). Neuromotor training can be achieved by limiting stability such as standing with both feet together, displacing the center of gravity as is done in yoga or tai chi, and or challenging the visual feedback by simply closing the eyes during some of the aforementioned exercises. The guidelines suggest that these exercises be performed 2-3 days a week for 20-30 minutes a session.

Functional training exercises incorporate both balance and agility skills. Balance is defined as the ability to adapt the body's center of mass with respect to its base of support. Having the ability to maintain balance, of course, is important both when standing still (static balance) and when moving the body through space (dynamic balance). In functional fitness training, the muscles are trained and developed in such a way as to make the performance of everyday activities easier, smoother, safer, and more efficient. Recent research has examined the efficacy of functional exercise training to improve balance, coordination, muscular force, power, and endurance, in addition to improving physical functional ability in middle-aged men and women and middle-aged, active duty military personnel (Pacheco, *et al*., 2013) [17]. In this context, the objectives of this study were to determine the efficacy of neuromotor and functional training on musculoskeletal fitness among middle aged women.

Methods

To achieve the purpose of the study forty five (N=45) middle aged women were randomly selected as subjects and their age ranged between 45 to 50 years. They were divided into three groups. Group I acted as Neuromotor training group (n=15), Group II acted as Functional training (n=15) and Group III acted as control group (n=15). The experimental groups participated in the respective training programme for a period of ten weeks. The subjects of the control group participated on their routine activities. They were informed about the objectives of the study, possible discomforts of the procedures, voluntary nature, right of secrecy, and possibility of withdrawal at any stage of the research, and after the acceptance of the study, they signed a free and informed consent form. Individuals who met the following criteria were included in the study: (a) age ≥45 to 50 years, (b) female sex, (c) answer to all items of the Physical Activity Readiness Questionnaire (PAR (Shephard, 1988) [20]. Individuals who had any of the following conditions were excluded from the study: (a) uncontrolled hypertension, (b) degenerative joint disease or joint implants, (c) cardiovascular and/or pulmonary disease precluding the practice of physical activity, or (d) neurological deterioration. Finally, the participants were advised to maintain normal dietary intake throughout the study. To assess Muscular strength was assessed via a one repetition maximum (1-RM) bench press and squat test (Logan *et al*. 2000). Muscular endurance was evaluated using a curl-up test (McGill 2004; Canadian Society for Exercise Physiology 2003). Flexibility was assessed using a modified sit-and-reach test and the best of three results was recorded to the nearest 0.1 cm as the final value (Canadian Society for Exercise Physiology 2003).

Training intervention

Neuromotor Training exercise was composed of 10 min of general warm-up, 25 min of conditioning and 15 min of floor exercises, all with the accompaniment of music. The warm up was performed by walking in different directions and progressively stretching all major joints i.e., shoulders, elbow, wrists, spine, hips, knees and ankles. The conditioning section included exercises for fine and gross motor coordination such as hand-eye or foot-eye coordination, static/dynamic balance, and agility, reaction ability and strength differentiation. These were implemented by requiring for example walking movements (a) of different dimensions (b) on path of different shape, (c) with different contact of the foot to the floor, (d) with quick motor reactions to different stimuli, (e) with different strength requirement. The floor part of the session included exercises strengthening the major muscle groups and relaxation exercises.

Functional training: Participants performed multifunctional, integrated and multi-joint exercises specific to their daily needs, and each session was divided into four sets: 1st 10 min of mobility for the main joints and general warm-up exercises that included 10 repetitions each of squats and jumps; 2nd 15 min of intermittent activities organized in circuit that required agility, coordination and muscle power; 3rd 20 min of multi-joint exercises for upper and lower limbs, with intense activation of stabilizing muscles of the spine, also organized in circuit; and 4th 10 min of intermittent activities.

Statistical analysis

The collected data were statistically analyzed with analysis of covariance (ANACOVA), whenever the "F" ratio for adjusted posttest means was found to be significant; the scheffe's test was applied as post hoc test to determine the paired mean differences. The level of confidence was fixed at 0.05 levels for all cases. SPSS version 25 (SPSS Inc., Chicago, IL, USA) was used to analyze all data.

Results of the study

The results presented in table I shows that the obtained adjusted post-test 'F' ratio value of 4.44 was greater than required table F ratio of 3.16 to be significant at 0.05 level. Hence, it was proved that there was significant improvement on muscular strength of the subjects due to the neuromotor and functional training treatment. The results presented in table II shows that the obtained adjusted post-test 'F' ratio value of 18.11 was greater than required table F ratio of 3.16 to be significant at 0.05 level. Hence, it was proved that there was significant improvement on muscular endurance of the subjects due to the neuromotor and functional training treatment. The results presented in table III shows that the obtained adjusted post-test 'F' ratio value of 71.02 was greater than required table F ratio of 3.16 to be significant at 0.05 level. Hence, it was proved that there was significant improvement on flexibility of the subjects due to the neuromotor and functional training treatment.

Table IV shows that the mean difference between neuromotor training group and functional training group was lesser than the required Scheffe's confidential interval. Hence, the difference between the experimental groups was non-significant. However, the difference between neuromotor training group and control group, functional training group and control group were greater than the confidence interval. Hence the differences are found to be significant at 0.05 level.

For better understanding of the results, pre, post and adjusted posttest mean values of neuromotor training group and functional training group and control group on musculoskeletal fitness were presented through bar diagram (Figure-1, 2 & 3).

Table 1: Computation of ANCOVA on muscular strength

Test	Neuromotor Training	Functional Training	Control Group	SV	SS	DF	MS	F
Pre-Test	22.80	23.00	21.87	B	10.98	2	5.489	1.74
				W	132.13	42	3.15	
Post-Test	25.53	26.00	21.80	B	158.98	2	79.49	6.23*
				W	536.13	42	12.77	
Adjusted	25.18	25.36	22.79	B	57.39	2	28.69	4.44*
				W	265.220	41	6.47	
Mean Gain	2.73	3.00	0.07					

*Significant at 0.05 level of confidence for 1 and 42 (df) = 3.17, 1 and 41 (df) = 3.16

Table 2: Computation of ANCOVA on Muscular Endurance

Test	Neuromotor Training	Functional Training	Control Group	SV	SS	DF	MS	F
Pre Test	19.33	18.60	18.73	B	4.58	2	2.289	1.34
				W	71.87	42	1.71	
Post Test	21.67	22.07	18.87	B	91.20	2	45.60	16.80*
				W	114.00	42	2.71	
Adjusted	21.47	22.20	18.94	B	87.69	2	43.85	18.11*
				W	99.272	41	2.42	
Mean Gain	2.33	3.47	0.13					

*Significant at 0.05 level of confidence for 1 and 42 (df) = 3.17, 1 and 41 (df) = 3.16

Table 3: Computation of ANCOVA on flexibility

Test	Neuromotor Training	Functional Training	Control Group	SV	SS	DF	MS	F
Pre Test	29.47	29.53	30.87	B	18.71	2	9.356	1.24
				W	317.20	42	7.55	
Post Test	32.13	32.80	30.27	B	51.73	2	25.87	3.71*
				W	293.07	42	6.98	
Adjusted	32.58	33.18	29.44	B	114.43	2	57.21	71.02*
				W	33.029	41	0.81	
Mean Gain	2.67	3.27	0.60					

*Significant at 0.05 level of confidence for 1 and 42 (df) = 3.17, 1 and 41 (df) = 3.16

Table 4: Scheffe's Post Hoc Test Analysis on Musculoskeletal Fitness

Variables	Neuromotor Training	Functional Training	Control Group	Mean difference	Required C.I
Muscular Strength	25.18	25.36	-	0.18	2.31
	25.18	-	22.79	2.40*	
	-	25.36	22.79	2.58*	
Muscular Endurance	21.47	22.20	-	0.73	1.41
	21.47	-	18.94	2.53*	
	-	22.20	18.94	3.26*	
Flexibility	32.58	33.18	-	0.61	0.82
	32.58	-	29.44	3.13*	
	-	33.18	29.44	3.74*	

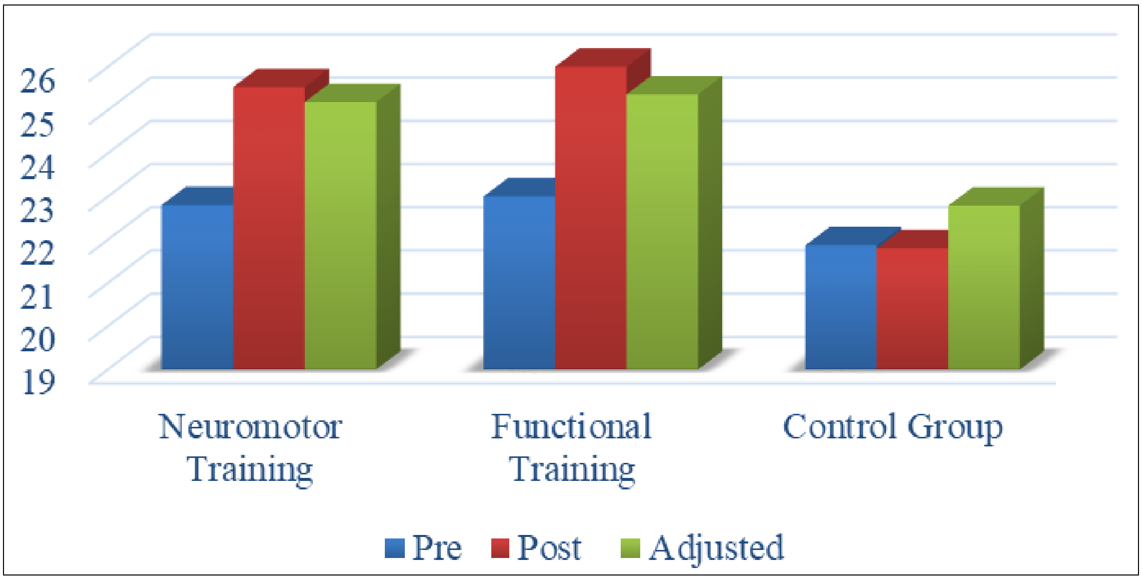

Fig 1: Bar diagram showing the Pre, Post and adjusted post-test means on Muscular Strength

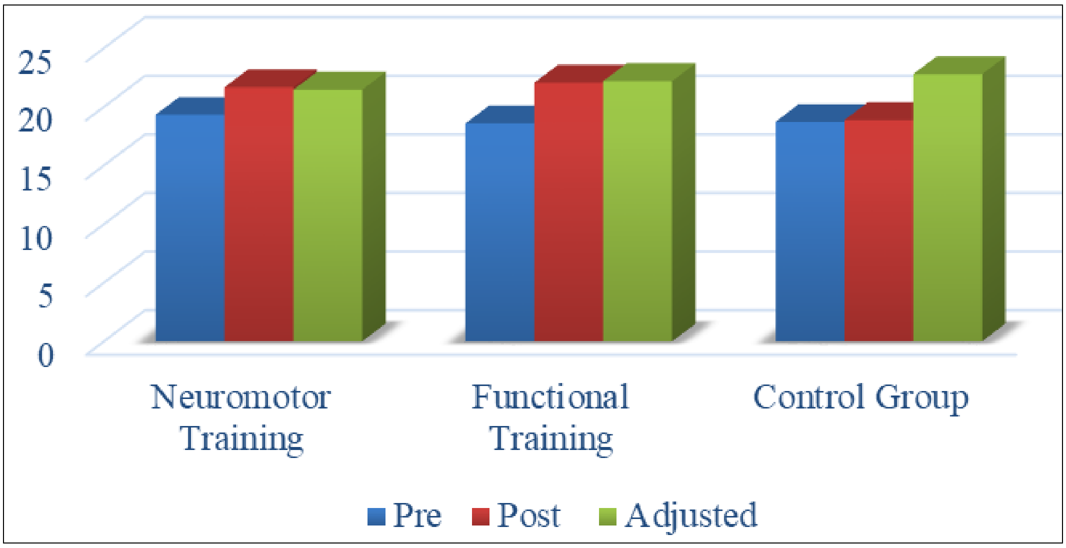

Fig 2: Bar diagram showing the Pre, Post and adjusted post-test means on Muscular Endurance

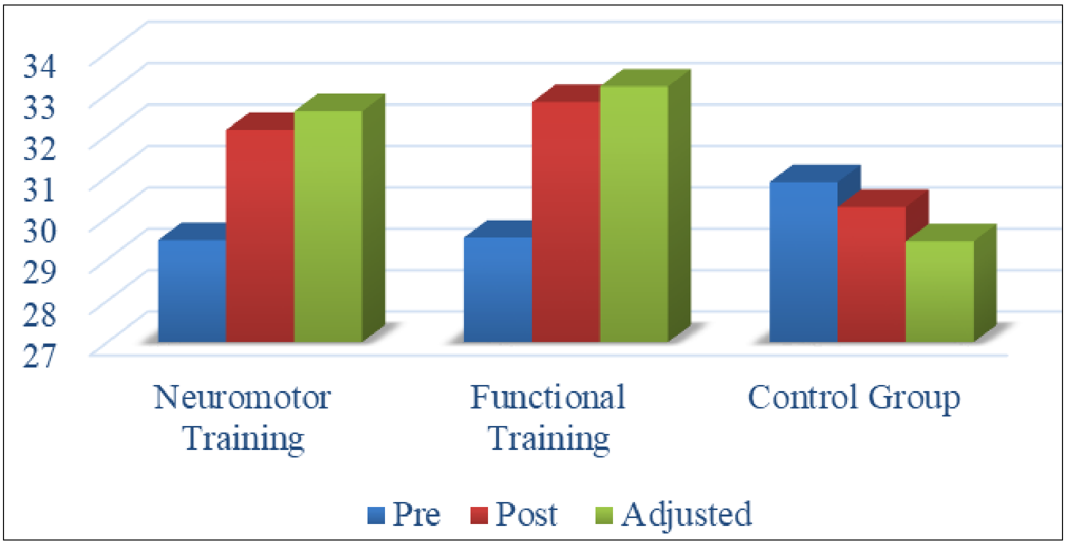

Fig 3: Bar diagram showing the Pre, Post and adjusted post-test means on Flexibility

Discussion and conclusion

The main finding of this study was that Neuromotor training and functional training improved the musculoskeletal fitness variables such as muscular strength, muscular endurance and flexibility. Neuromotor exercise training and functional training beyond activities of daily living to improve and maintain physical fitness and health is essential for most adults. Muscle tissue is an important element of overall body composition. Greater muscle mass means a higher rate of metabolism and faster energy use. Training to build muscular strength can also help people manage stress and boost their self-confidence. De Vreede *et al.* (2005) [6] found that lower body strength and overall functional task performance were improved after a 12-week functional resistance program. Milton and colleagues (2008) also found that after 4 weeks of functional training, their older adult participants made significant improvements in upper body strength and lower body strength. Maintaining strength and muscle mass is vital for healthy aging. Muscular endurance helps to complete daily tasks and take part in recreational activities without tiring easily. Regular exercises help the development of muscle strength, muscle endurance, and flexibility (Herward, 1991) [11]. A range of body tissues can influence flexibility. Our data indicated that a mix of multi-joint exercises, especially those that involve the hip joint and movement in multiple planes, can maintain or possibly enhance flexibility in that region. Whitehurst and colleagues (2005) found similar improvements in sit-and-reach flexibility following a functional training program in older adults. In a study, Rogers and Gibson,(2006) carried out to determine the effect of 8 weeks mat work Pilates exercises improvements in muscle endurance and flexibility of the participants of the adults. Segal *et al.* (2004) [19] reported that Pilate's exercises had effect on increasing flexibility in their study.

It was concluded that, the result of the study proved that Neuromotor and Functional training may be sustainable by individuals living in the long-term care setting and may help to preserve the independence of ageing people. Our findings suggest that a training programme significantly improved musculoskeletal fitness among middle aged women.

Reference

1. American College of Sports Medicine. ACSM's Resources for the Personal Trainer, 2nd ed. Lippincott, Williams & Wilkins, Baltimore, MD; c2007.
2. American College of Sports Medicine ACSM's resource manual for guidelines for exercise testing and prescription author: American College of Sports Medicine. Lea & Febiger, Philadelphia; c2009.
3. American College of Sports Medicine. ACSM's

guidelines for exercise testing and prescription. 9th edition. Chapters 7 and 34. Baltimore, MD: Wolters Kluwer/Lippincott Williams & Wilkins; c2014.

4. Bird M, Hill KD, Ball M, Hetherington S, Williams AD. The long-term benefits of a multi-component exercise intervention to balance and mobility in healthy older adults: Relationship between physical functioning and physical activity in the lifestyle interventions and independence for elders pilot. Archives of Gerontology and Geriatrics. 2010;58(10):1918-24.
5. Canadian Society for Exercise Physiology. The Canadian Physical Activity, Fitness & Lifestyle Approach: CSEP-Health and Fitness Program’s Health-Related Appraisal and Counseling Strategy, 3rd ed. Canadian Society for Exercise Physiology, Ottawa, Ontario, Canada; c2003.
6. de Vreede P, Samson M, van Meeteren N, Duursma S, Verhaar H. Functional-task exercise versus resistance strength exercise toimprove daily function in older women: a randomized, controlled trial. J Am Geriatr Soc. 2005;53:2-10.
7. Forte R, Boreham CAG, Costa Leite J, De Vito G, Brennan L, Gibney ER, *et al*. enhancing cognitive functioning in the elderly: multicomponent vs. resistance training. Clin Interv Aging. 2013;8:19–27.
8. Garatachea N, Pareja-Galeano H, Sanchis-Gomar F, *et al*. Exercise attenuates the major hallmarks of aging. Rejuvenation Res. 2015;18(1):57-89.
9. Henwood TR, Taaffe DR. Short-term resistance training and the older adult: the effect of varied programmes for the enhancement of muscle strength and functional performance. Clin Physiol Funct Imaging. 2006;26:305-313.
10. Garber C, Blissmer B, Deschenes M, Franklin B, Lamonte M, Lee I, *et al*. American College of Sports Medicine position stand. Quantity and quality of exercise for develop-ing and maintaining cardiorespiratory, musculoskel-etal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. Medicine & Science in Sports & Exercise. 2011;43(7):1334-59.
11. Herward UH. Advanced fitness assesmend exercise prescription 1st edition. Texas; uman kinetics books; c1991. p. 12-13.
12. Logan P, Fornasiero D, Abernathy P, Lynch K. Protocols for the assessment of isoinertial strength. In: Fore CJ (Ed.), Physiological Tests for Elite Athletes. Human Kinetics, Champaign, IL; c2000.
13. McGill S. Ultimate Back Fitness and Performance. Wabuno Publishers, Waterloo, Ontario, Canada; c2004.
14. Milton D, Porcari J, Foster C, Gibson M, Udermann B. The effect of functional exercise training on functional fitness levels of older adults. Gunderson Lutheran Med J. 2008;5:4–8.
15. Nelson ME, Rejeski WJ, Blair SN, *et al*. Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Associa-tion. Medicine & Science in Sports & Exercise. 2007;39(8):1435-45.
16. NSCA’s Essentials of Strength Training and Conditioning, 3rd ed. Baechle TR, Earle RW (Eds.). Human Kinetics, Champaign, IL; c2008.
17. Pacheco MM, Teixeira LA, Franchini E, Takito MY. Functional vs. strength training in adults: specific needs define the best intervention. Int. J Sports Phys Ther. 2013;8(1):34-43. Epub 2013/02/27.
18. Rogers K, Gibson AL. Eight-week traditional mat Pilate’s training-program effects on adult fitness characteristics. Res Q Exercıse Sport. 2009;80(3):569-574.
19. Segal NA, Hein J, Basford JR. The effects of Pilates training on flexibility and body composition: an observational study. Arch Phys Med Rehab. 2004;85(12):1977-81.
20. Shephard R. PAR-Q Canadian home fitness test and exercise screening alternatives. Sports Med. 1988;5(3):185-195.
21. Whitehurst M, Johnson B, Parker C, Brown L, Ford A. The benefits of a functional exercise circuit for older adults. J Strength Cond Res. 2005;19:647-51.