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Comparative on the Effectiveness of a Combined Exercise Approach (NASM) on the Musculoskeletal Disorders and Physical Fitness Parameters of Male Students

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Students may suffer from less activity due to their studies and research work, resulting in musculoskeletal disorders (MSDs), poor physical fitness, and a variety of non-transmissible diseases, particularly at early entrance to the university. Therefore, this study aimed to compare the effectiveness of NASM-based combined training exercise on MSDs and physical fitness parameters (PFPs) of male students. In this semi-experimental study, 40 male students aged 18-20 years from Isfahan University of Technology were selected as subjects and randomly divided into experimental and control groups. The experimental group participated in the NASM training sessions for 8 weeks, three sessions per week and 1 hour per session. Before and after the intervention, levels of MSDs were assessed through New York test (to achieve a total score) and physical fitness of subjects by measuring muscle strength, flexibility, cardiovascular capacity, and agility. Data were analyzed by the repeated measures analyses of variance (ANOVA) using SPSS V. 24 software. Results indicated significant MSDs (p=0.001) and PFPs such as weight (p=0.018), flexibility (p=0.001), agility (p=0.001), strength (P=0.005), and maximum oxygen consumption (p=0.005). There were significant differences in all PFPs and MSDs in pretest compared to posttest ($p \geq 0.05$). No significant difference was observed in the group interaction with the weight measurement step (p=0.159). The results showed that some PFPs, such as flexibility, strength, and cardiovascular endurance, reduce in individuals with MSDs. By performing NASM-based combined training exercises, MSDs can be reduced to a great extent, thereby, improving the PFPs. Musculoskeletal abnormalities, combined exercises (NASM), physical fitness.

Keywords: Musculoskeletal abnormalities, combined exercises (NASM), physical fitness.

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Introduction

Physical health and having a desirable physical condition are very important in human life and its positive and negative changes can affect other aspects of life. Musculoskeletal disorders (MSDs) occur in individuals posing long-term inappropriate conditions while working and in daily activities. This will lead to negative effects on the muscles, tendons, ligaments, joints, peripheral nerves, and blood vessel support involving various areas of the body including the lower back, neck, shoulders, lower extremities, forearms, and hands [1, 2, and3]. Repetitive movements or continuous postures can result in modulations in muscle length, strength, and stiffness; thus, such adaptations may cause motor disorders [2]. In other words, MSDs can cause motor disorders in various organs of the body [4] imposing considerable treatment costs [5].

Desirable physical fitness plays an important role in the health of the community as physical and psychological illnesses and discomforts result from inactivity, mechanized life, and low physical fitness in majority of cases [6 and 7].The consequences of inappropriate physical condition are so extensive that it has high negative impacts

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on the physical, psychological, economic, and social dimensions [8]. According to numerous studies that have examined the role of physical activity as a physical fitness intervention on the improvement of MSDs, the main cause of MSDs can be attributed to low physical fitness parameters (PFPs), such as muscular strength and endurance, cardiovascular capacity, balance, and flexibility [9 and 10].

In order to improve PFPs and MSDs, a variety of training protocols have been presented by researchers. Recently, the USA National Academy of Sports Medicine (NASM) presented a new corrective protocol comprising four stages of inhibition, stretching, activation, and integration techniques [11]. The protocol recommends that, instead of simply stretching the shortened or stiff muscle, it is advisable to first apply inhibition exercises and then stretching exercises on the muscle. In the self-myo-facial release technique, the receptors are stimulated to provide an inhibitory response in the muscle spindle and to reduce the gamma activity by continuous pressure with a certain intensity, amount, and duration. This concept was supported by a controlled experiment by Ho et al., who reported that pressure could significantly increase the range of motion through a high-intensity object (maximum pain tolerance) for a short time of 30 seconds, or low intensity (minimum pain tolerance) for a longer time of 90 seconds [12]. Also, rather than merely strengthening weakened muscles, it is better to use the integration exercises in the end [11].

Because MSDs come with lots of complexities, it seems necessary to utilize updated exercise protocols to correct and rehabilitate these disorders. However, exercises should be considered that, in addition to focusing on the level of abnormality, can improve PFPs as the main preventative factors in the occurrence of MSDs. In addition, no research has been found to examine the effect of NASM on the PFPs and MSDs. Therefore, this study aimed to compare the effectiveness of combined training exercises with NASM approach on MSDs and PFPs of male students.

Materials and methods

The present study was quasi-experimental with pretest-posttest design conducted on non-athlete male students at Isfahan University of Technology in 2018. Of this population, 40 individuals were selected as the subjects with purposive convenience sampling method, and randomly divided into experimental and control groups. Before participating in the research, all subjects completed consent forms and were then evaluated for MSDs and PFPs before and after the intervention. The present study was started after the project approval and receiving the Code of Ethics from Isfahan University of Technology. The inclusion criteria were no history of regular physical activity, physical illness, mental illness, upper and lower spinal surgery, and no use of specific medications. Exclusion criteria included a history of physical activity, mental illness, spinal surgery, and those with lower back pain during the research, whom were excluded because this pain was likely to affect their posture type.

MSDs were assessed by the New York self-evaluation-based questionnaire, chessboard, and mirror box. PFPs were evaluated by an electronic dynamometer to determine the strength of the leg and back muscles, and Queens step test to measure cardiovascular fitness. The subjects' flexibility was determined with sit-and-reach test.

New York test: This was used as an observational and self-evaluation-based test through a chessboard to measure MSDs in individuals. Studies have reported levels of reliability and validity for such observational and self-evaluation-based methods as the chessboard [13]. In a domestic investigation, Ganji showed the reliability of the New York test at 95% confidence in spinal measurement examined by two testers [14]. Scores in this test were recorded while subjects were positioned from the side and posterior aspects with minimal clothing standing on bare feet in front of a chessboard. The evaluator began to evaluate 11 types of MSDs from 3-4 m, and then recorded the evaluation data in a form prepared according to the Likert scale (normal, mild, and severe). The severity of disorders for each section and a total score were recorded as physical abnormalities of the subjects.

Foot and trunk muscle strength test: This test was used to measure the leg and trunk muscle strength of the subjects by an electronic dynamometer device. A very high (97%) reliability has been reported for the dynamometer [15]. The subject stood up on the board with bent knees while grasping the dynamometer knob and pulled it upward with full power using the strength of leg and back muscles. The number on the device displayed the muscle strength level of the subject.

Queens step test: This test is used to measure maximum oxygen consumption of individuals or, in other words, the cardiovascular capacity. In a study on the Queens test, Hessam et al. reported a reliability of 88% indicating a good reliability for this test [16]. The subjects started walking up and down on a step (40 cm height) with a steady rhythm for 3 minutes. Then, subjects' heart rates were measured and introduced to a digital set of Queens test to calculate and record the cardiovascular capacity of the subjects.

4×9 m shuttle-run (agility) test: This type of running measures agility. The subject was placed behind the starter line, started running after hearing "go", and traveled 9 m speedily. After reaching the end line, the subject traveled back the route to the start line and ran the 9-meter shuttle route once more. On the return, the subject passed over the start line and the chronometer time was recorded for the subject [17].

Sit-and-reach test (flexibility): This test has been designed and implemented to measure the overall body's flexibility. This test is taken by a graduated box to measure the flexibility of hamstring muscles. To this end, the subject was sat on the ground while the knee joint was wide open and placing the sole on the general surface of test box. The subject then put his hands on one another while the palms were downward and took forward the knees as far as possible while knees were straight and kept them on the horizontal and graduated test surface for 2 seconds. The test was repeated 3 times and the highest score was considered as the subject's score. This test has been taken from the series of AAHPERD tests. This test was measured by a box equipped with an electronic flexibility measuring device [18].

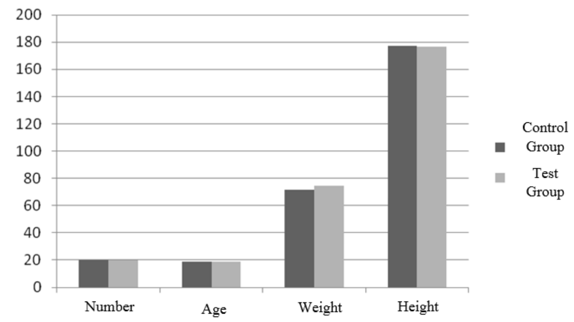
Instructions for combined exercises with NASM approach: The subjects were asked to practice NASM for 8 weeks in three sessions each for one hour. Initially, the warming up program was performed for 10 minutes, then the 40-minute training session, including NASM's deep-sensory strength training, was completed and finally, 10 min was devoted to cooling. The training protocol included four stages of inhibition, stretching, activation, and integration [11]. In the inhibition technique, the release of tension was done using a roller foam (hard type), which increases pressure on soft tissue structures and access to deep fascia layers. In this exercise, the subject moved the roller foam onto the intended area for 30 seconds [11]. Stretching technique was used to increase elasticity, length, and range of bodily soft tissues. Each stretch was maintained for 30 seconds. The activation technique was used to retrain or increase the activity of tissues with low activity. These exercises were performed with 10-15 repetitions. The integration technique was used to retrain and coordinate the nerve and muscle functions through progressive functional motions, which included the use of entire dynamic body exercises based on the motor and enduring muscles of the body.

Data were organized by descriptive statistics in Excel 2016 software and then analyzed by the combined repeated measures analysis of variance (ANOVA) using SPSS V. 24 software.

Results

As indicated in Figure 1, the control and experimental subjects were examined for age, weight, and height in terms of homogenization. There were 20 subjects in each experimental and control group, with mean ages of 18.8 and 18.7 years in the former and the latter, respectively. Mean weight was 74.3 kg in the experimental subjects and 71.5 kg in the control. The experimental and control subjects had mean heights of 176.6 and 177.1 cm, respectively

Figure1. Demographics of the subjects



As shown in Table 1, the NASM approach, in addition to a significant improvement in MSDs (p = 0.001), could improve PFPs such as weight (p = 0.018), flexibility (p = 0.001), agility (p = 0.001), strength (p = 0.005), and maximum oxygen consumption (p = 0.005).

Table 1. Paired comparison of the research variables before and after the intervention in the experimental and control groups

Variables		t	Sig.
Weight	Control	0·476	0·639
	Experimental	2·585	0·018*
Flexibility	Control	-0·462	0·649
	Experimental	-6·866	0·001*
Agility	Control	1·065	0·301
	Experimental	5·105	0·001*
Strength	Control	1·125	0·275
	Experimental	-3·167	0·005*
Maximum oxygen consumption	Control	0·645	0·527
	Experimental	-3·208	0·005*
Total disorder score	Control	-0·809	0·428
	Experimental	-10·758	0·001*

* Indicates significance level.

As shown in Table 2, the values of combined repeated measures ANOVA indicate that the intra-group effects related to the measurement stage, and the group interaction × the measurement step are statistically significant as indicated with asterisks (*) in the table (P < 0.05). In fact, significance of the interaction means that the research groups behaved differently at different measurement times. The significance of the group effect means the overall difference between the mean scores related to some physical fitness subscales and MSDs among the experimental and control groups. There were significant differences in all PFPs and MSDs in pretest compared to posttest (P < 0.05). No significant difference was observed only in the interaction of the group with the weight measurement step (p = 0.159).

Table 2. Combined repeated measure ANOVA related to intra-group effects

Variables		t	Sig.
Weight	Control	0·476	0·639
	Experimental	2·585	0·018*
Flexibility	Control	-0·462	0·649
	Experimental	-6·866	0·001*
Agility	Control	1·065	0·301
	Experimental	5·105	0·001*
Strength	Control	1·125	0·275
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Maximum oxygen consumption	Control	0·645	0·527
	Experimental	-3·208	0·005*
Total disorder score	Control	-0·809	0·428
	Experimental	-10·758	0·001*

* Indicates significance level.

Discussion

The aim of this study was to compare the effectiveness of combined training exercises with the NASM approach on MSDs and PFPs of male students. The findings of the study showed significant improvements in the status of MSDs and some of PFPs such as muscle strength, flexibility, maximum oxygen consumption, and agility of the combined exercise group after 8 weeks of training. Several factors contribute to the development of MSDs, which can be corrected by adopting a regular corrective program. Some PFPs may be affected after MSDs ultimately leading to weakness. Since the PFPs are interdependent, deficits in one may dramatically influence another one, and any weakness in the PFPs caused by MSDs needs correction and rehabilitation [10]. The results of this study showed that combined training with NASM approach could improve MSDs and subsequently some of the PFPs.

A study by Hunton et al. (2000), who used two self-myofascial release and stretching techniques, is similar to the current research [19]. Hyndel et al. (2012) examined the mechanism and effect of neuromuscular stretching exercises on the muscle range of motion and function and concluded that neuromuscular stretching improved muscle strength and range of motion [20]. Donald et al. (2013) used the inhibition technique and showed that the two-minute self-myofascial release technique significantly increased the motion range of quadriceps muscle with no definite effects on the force production and development [21]. Lennigan and Harrison (2012) showed that the self-myo-phasic release technique on the sole had a positive effect on the reactive strength profile and vertical jump in the one-leg jump-hop test [22]. Biret (2004) applied an isometric activation technique and stretching exercises to increase the strength of erector spine muscles in people with kyphosis, and eventually found that increased muscle strength played an important role in maintaining posture and improved kyphosis abnormality [23]. The positive results of these exercises are consistent with those of this study.

The strength and endurance of abdominal muscles are one of the important factors in the prevention of low back pain and various MSDs. People with muscular weakness often suffer from muscle soreness and are easily susceptible to multiple damage [24]. The strength and endurance of abdominal muscles are considered as one of the most important factors in health-related physical fitness [24]. An increase in lumbar lordosis is probably due to weakened abdominal muscles, particularly the rectus abdominis muscle. Hence, supportive programs are prescribed for the muscle correction and treatment, and abdominal strengthening exercises should be performed to prevent anterior pelvic tilt and lumbar lordosis rise.

The subjects were evaluated for lumbar flexibility as one of the health-related fitness parameters [25]. The relaxing lower back muscles have a direct effect on the lumbar lordosis due to the reduced posterior distance between the vertebrae and attachment to the lumbar structure; the shortness of these muscles causes anterior pelvic orientation maintaining lumbar lordosis. Apart from the body posture, when these muscles shorten, the waist poses in some degrees of extension, the level of which is equal to the shortness of the above muscles [26]. Therefore, decreased flexibility of the above muscles is a risk factor for increasing lumbar lordosis. The results of this study indicate that the posttest levels of flexibility were significantly different between the experimental and control groups, which is in line with those of Kaykhaye Hosseinpour et al. [27] and Ghorbani et al. [28].

Kyphosis is associated with such fallouts as impaired physical and motor functions, as well as problems with pulmonary function and increased probability of vertebral fractures. In addition, patients with kyphosis suffer from limited movement in the upper extremity, along with decreased chest expandability. In this regard, research evidence suggests that levels of respiratory indices in the group with kyphosis are significantly lower than those of normal groups. Exercise increases the amount of metabolic activities and, to respond to it, the pulmonary ventilation and cardiac system should act simultaneously to increase the amount of minute ventilation and cardiac output. The function of cardiovascular muscles improves as a result of exercise, which can improve cardiovascular parameters such as cardiovascular capacity, tidal volume, end-inspiratory and expiratory volumes, inspiratory and expiratory flow rates, and so on. [29]. According to our observations, corrective exercises with NASM approach can improve kyphosis and subsequently promote cardiovascular parameters, especially cardiovascular capacity, which is in agreement with Alizadeh et al. [2011; 30], Cado et al. [2005; 31], Harrison et al. [2007; 32], and Hong et al. [2005; 33].

There is a direct correlation between PFPs and agility with MSDs. Since agility is the outcome of all PFPs, an improvement in this factor can be indicative of improvements in MSDs, as demonstrated in this research and also by those of Nikroo et al. [2014; 34] Jafari et al., [2014; 35], Arazi [2015; 36], and Taheri et al. [2017; 37].

Conclusion

Due to the nature of their work and spending part of times for studying, students suffer from impaired mobility. In addition, maintaining improper physical postures (study position, working on computers, sitting, standing, and so on.) for long times have led to a variety of MSDs among students. Our findings showed that some of PFPs such as flexibility, muscular strength, cardiovascular endurance, and agility decrease in students with MSDs. Providing corrective exercises, especially combined exercises with the NASM approach, can improve MSDs in addition to improving PFPs. It is, therefore, recommended that therapists, reflexology practitioners, and instructors to use these types of exercises to reduce MSDs and improve PFPs..

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Conflicts of interest

None.

References

1. Andersen JH, Kaergaard A, Frost P, Thomsen JF, Bonde JP, Fallentin N et al. Physical, psychosocial, and individual risk factors for neck/shoulder pain with pressure tenderness in the muscles among workers performing monotonous, repetitive work. Spine 2002; 27 (6): 660-7

2. Tirgar A; Khallaghi S; Taghipour M. A study on musculoskeletal disorders and personal and occupational risk factors among surgeons, Iranian J Health Scie. 2013; 1 (1), 50-7.

3. Sahrmann S. Movement system impairment syndromes of the extremities, cervical and thoracic spines: Elsevier Health Sciences 2010; 37(8):1447-49.

4. Dormohammadi A, Zarei E ,Normohammadi Mr, Sarsangi V, Amjad Sh, Asghari M. Risk Assessment of Computer Users ‘upper Musculoskeletal Limbs Disorders in a Power Company by Means of Rula Method And Nmq in 2014;20(4):521-29.

5. Coledam, D. H. C, Júnior, R. P, Ribeiro, E. A. G, & de Oliveira A. R. Factors associated with musculoskeletal disorders and disability in elementary teachers: A cross-sectional study. Journal of Bodywork and Movement Therapies.2018:1-8

6. Fanning, J., Walkup, M. P., Ambrosius, W. T., Brawley, L. R., Ip, E. H., Marsh, A. P., & Rejeski, W. J.. Change in health-related quality of life and social cognitive outcomes in obese, older adults in a randomized controlled weight loss trial: Does physical activity behavior matter? Journal of behavioral medicine 2018; 41(3): 299-308.

7. Khavari L, Nazem F, Yousefian J, Farahpoor N. Examining the pattern of changes in fat percentage, body massindex, density and configuration of girls 13 to 17 years in Hamadan. Harekat. 2007;30(30):139-150

8. Henok, A., & Bekele, T. Prevalence of musculoskeletal pain and factors associated with kyphosis among pedestrian back-loading women

in selected towns of Bench Maji zone, Southwest Ethiopia. Ethiopian Journal of Health Development, 2017;31(2): 103-9

9. Korovessis P, Koureas G, Papazisis Z. Correlation between backpack weight and way of carrying, sagittal and frontal spinal curvature, athletic, activity, and dorsal and low back pain in schoolchildren and adolescents. J Spinal Disord Tech 2004; 17(1):33-40.

10. Patel K. Corrective Exercise: A Practical Approach. London: Hodder Arnold; 1st Edition. 2005.

11. Clark M, Lucett S. NASM essentials of corrective exercise training. Lippincott Williams & Wilkins; 2010.

12. Fuentes, J. P., Armijo Olivo, S., Magee, D. J., & Gross, D. P. Effectiveness of interferential current therapy in the management of musculoskeletal pain: a systematic review and meta-analysis. Physical therapy 2010; 90(9): 1219-38.

13. Willams M. A, McCarthy CJ. Chorti A, Cooke MW, Gates S A systematic review of reliability and validity studies of methods for measuring active and passive cervical range of motion. J Manipulative physiol Ther 2010; 33(2): 138-55.

14. Ganji B, Nasser M, Mohammad H, Ali Zadeh, M.H. The validity and reliability of the New York test for measurement of spinal arches. Physical Education and Sport Sciences. 2009;1(4):23-28

15. Mathiowetz, V ,Weber K, Volland G & Kashman N. (). Reliability and validity of hand strength evaluation. Jornal of hand surgery, 1984;9(2): 222-6.

16. Qasem H, Ebrahimi M. H, Khosravi F, Sattari R, Dehghani F, et al. Validity and Reliability of the Height Adjustable Step for Step Test. Journal of Knowledge and Health. 2016: 11(2): 38-43.

17. Hadavi F. Measurement and Evaluation in Physical Education. Hatmi; 2016. [Persian]

18. Zolaktaf V, Akbari S Comparison of the effect of static and PNF stretching exercises with a reassessment of the test validity of the site & reach test. Olympic. 2004;12(3):17-28. [Persian]

19. Hanten WP, Olson SL, Butts NL, Nowicki AL. Effectiveness of a home program of ischemic pressure followed by sustained stretch for treatment of myofascial trigger points. Physical therapy. 2000; 80(10):997-1003.

20. Hindle K, Whitcomb T, Briggs W, Hong J. Proprioceptive neuromuscular facilitation (PNF): Its mechanisms and effects on range of motion and muscular function. Journal of human kinetics 2012;.31:105-13.

21. Donald GZ, Penney MD, Mullaley ME, Cuconato AL, Drake CD, Behm DG, et al. An acute bout of self-myofascial release increases range of motion without a subsequent decrease in muscle activation or force. The Journal of Strength & Conditioning Research ; 2013;27(3):812-21.

22. Lanigan CS, Harrison AJ.The Effects of Self Myofascial Release on the Plantar Surface of the Foot During Sledge Rebound Jumps. Journal of Bodywork and Movement Therapies. 2012; 16(4):521-2.

23. Burret & E. (2004). Kyphosis. (Curvature of the spine) Available from: http://www.orthopaedicweblinks.com/Detailed/1061.html

24. S,Heimer. Misigoj-Duraković M, Ruzić L, Matković B, Prskalo I, Beri S et al "Fitness Level of Adult Economically Active Population in the Republic of Croatia Estimated by Eurofit". System, Coll. Antropol.2004;28(1):223–33.

25. Sana Stroth, Sabine Kubesch, & Kathrin Dieterle. "Physical fitness, but not acute exercise modulates event-related potential indices for executive control in healthy adolescents, Elsevier 2009;1269:114-24.

26. Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. Muscles: Testing and function, with posture and pain (Kendall, Muscles). Philadelphia: Lippincott Williams & Wilkins; 2005.

27. Keykhahoseinpoor A, Rahnama N, Chitsaz A.. Effects of eight weeks laughter yoga training on motor function, balance, and flexibility in subjects with Parkinson's disease. Journal of Research in Rehabilitation Sciences 2013; 9(1):39-47.

28. Ghorbani L, Ghasemi. G. Effects of Eight Weeks Corrective Exercises on Lumbar Lordosis. Research in Rehabilitation Sciences. 2008;3(2):59-71.

29. Meamari H, Koushkie Jahromi M, Fallahi A, Sheikholeslami R. Influence of Structural Corrective and Respiratory Exercises on Cardiorespiratory Indices of Male Children Afflicted with Kyphosis. jrehab. 2017; 18 (1): 51-62.

30. Alizade MH, Gharakhanloo R, Daneshmandi H. Corrective movement (Diagnosis and exercise prescriptions). Tehran: Samt Publisher. 2011.

31. Kado DM, Huang M-H, Barrett-Connor E, Greendale GA. Hyperkyphotic posture and poor physical functional ability in older community-dwelling men and women: the Rancho Bernardo study. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2005; 60(5):633-7.

32. Harrison RA, Siminoski K, Vethanayagam D, Majumdar SR. Osteoporosis-related kyphosis and impairments in pulmonary function: a systematic review. Journal of Bone and Mineral Research. 2007; 22(3):447-57.

33. Huang MH, Barrett-Connor E, Greendale GA, Kado DM. Hyperkyphotic posture and risk of future osteoporotic fractures: the Rancho Bernardo study. Journal of Bone and Mineral Research. 2005; 21(3):419-23.
34. Nikroo H, Barancheshme, Azoore. The comparison of the effects of combined selection of exercises and current sports activities on the improvement of physical fitness of soldiers during the training term of national service. J Mil Med. 2014;16(1):9-16.
35. jaafari M, akhgar R, mohammad hasan zadeh N. Comparison of effectiveness of Karate, Taekwondo and Judo training on physical fitness and cardiovascular risk factors in students of Imam-Hossein University. J Mil Med. 2014;16(2):83-91.
36. Arazi H, Moayeri rad F, Aboutalebi S. The Impacts of Two Aerobic Training Programs (Rope Jumping and Running) on Physical Factors in Boys with Intellectual Disability. JOEC. 2017;16(4):15-26.
37. Taheri M, Irandoost K, Yousefi S, Jamali A. Effect of 8-Week Lower Extremity Weight-Bearing Exercise Protocol and Acute Caffeine Consumption on Reaction Time in Postmenopausal Women. sija. 2017;12(1):18-29.