Original Article

DOI: http://dx.doi.org/10.16926/par.2018.06.10

Effects of eight weeks of TRX versus traditional resistance training on physical fitness factors and extremities perimeter of non-athlete underweight females

Hamid Arazi[ACDE], Fatemeh Malakoutinia[BCDE], Mani Izadi[CD]

Department of Exercise Physiology, Faculty of Sport Sciences, University of Guilan, Rasht, Iran

Authors' Contribution: A – Study Design, B – Data Collection, C – Statistical Analysis, D – Manuscript Preparation, E – Funds Collection

Abstract

Introduction: New form of suspension training (TRX) has been introduced which has the ability to develop physical fitness factors. The aim of this study was to compare the effects of eight weeks of resistance training by traditional and TRX methods on physical fitness factors and extremities perimeter of non-athlete underweight girls. *Material and methods:* Thirty non-athlete underweight female students qualified with an average age of 23±1.64 years, weight of 43.53±0.28 kg, height of 162.66±6.6 cm and BMI of 16.31±0.2 kg/m^2 were selected and randomly assigned into three groups of 10 subjects (traditional, TRX and control). Participants performed training of 3 sessions per week for eight weeks. Before and after the period of training, physical fitness variables including muscular strength and endurance, flexibility, thigh and arm circumferences were measured. *Results:* The results showed that both forms of training had a significant effect on muscular strength and endurance. There was no significant difference in flexibility and thigh and arm circumferences. *Conclusion:* It can be concluded, that the traditional and TRX training have created almost same improvements in physical fitness factors, so TRX training can be considered an efficient choice to do alongside traditional training or as its alternative in order to earn desired training achievements. It is noteworthy that when training goal is to enhance muscular strength and endurance especially in upper-body, TRX training appears to be accompanied by greater gains compared to traditional resistance training.

Keywords: functional training, weight training, strength gain, hypertrophy.

Address for correspondence: Hamid Arazi - Department of Exercise Physiology, Faculty of Sport Sciences, University of Guilan, Rasht, Iran. e-mail: hamidarazi@yahoo.com

Recevied: 12.04.2017; Accepted: 22.10.2017; Published online: 25.04.2018

Cite this article as: Arazi H, Malakoutinia F, Izadi M. Effects of eight weeks of TRX versus traditional resistance training on physical fitness factors and extremities perimeter of non-athlete underweight females, Physical Activity Review 2018, 6: 73-80. doi: http://dx.doi.org/10.16926/par.2018.06.10

INTRODUCTION

The fitness enthusiasts, recreational weight trainers, and athletes all take advantage of resistance training programs in order to gain muscle size and physical fitness factors such as muscular strength and endurance. Additionally, the resistance exercise is a major component of training programs in most sports and plays an effective role in injury prevention and rehabilitation. These goals can be accomplished using various types of resistance training modalities [1,2].

Traditional trainings are accompanied by fixed and mobile equipment in which the exercises are performed in certain ranges of motion and difficultly, that can be used in everyday life [3]. Traditional training is known as a common training program because of its positive effects on improving muscular strength and power [4,5].

Functional training is a specific strength training that properly involves the muscles, that are required for the implementation of daily life, including suspension training that is conducted in different from other resistance trainings [6]. Weiss et al. [7] showed that traditional and functional training programs provide similar results in muscular strength, core muscular endurance and balance. However, flexibility had greater increase in functional training group.

The suspension training has different forms, that have in common unstable surface and only used tool is different. These exercises can cause more activation in motor units of muscles [5,8]. The use of suspension equipment is a popular choice among fitness enthusiasts. This training method is recommended to people whose aim to achieve functional strength and health. Although suspension training is characterized as an innovative training method, but the history of using these devices goes back to classical gymnastic rings [8].

Few studies have been done on unstable strength training programs. Additionally, most of these researches have examined the physiological mechanisms of stability control [9], and little data exists regarding the effects of balance on functional attributes such as power and strength [10,11].

TRX (Total-Body Resistance Exercise) is a kind of new functional training, which as suspension training allows people to use their body weight (or force exerted by the gravity force) as resistance during exercise with several motor plates as well as muscle and joint groups. In a research, Janot et al. [12] compared the traditional and TRX trainings, and results showed that TRX training improves muscular fitness in both youth and adult groups similar to traditional resistance training.

In order to evaluate the real effect of a strength training program regardless of unstable and stable conditions, it is important to keep the training load constant. However, the principle of training overload is necessary to challenge training adaptations. Resistances in most unstable surface training exercises can be body weight, and the magnitude of exercise load depends on the degree of instability, which is provided by devices and body positions. This makes it difficult to prescribe a given exercise intensity and volume. One way to control the magnitude of effort in such conditions can be used by the rating of perceived exertion (RPE), which is measured by assigning a numerical score at the end of each exercise and each training session [13].

Up to now, there is no certain criterion for quantifying the instability produced by different devices or postural changes for determining the real magnitude of effort and load. Currently, little information is also available on the benefits of TRX as a model of functional training compared to traditional resistance training programs. Accordingly, the aim of this study was to compare the resistance training results between the traditional method and TRX on the factors of strength, muscular endurance, flexibility and extremities perimeter in non-athlete underweight females.

MATERIAL AND METHODS

The present quasi-experimental research was conducted on three groups of control, TRX training and traditional training in which the participants took part in a plan with pre-test and post-test. In the current study, after inviting individuals to participate in the research period, those who voluntarily interested in the project were referred to gym with personal consent. After evaluating body mass index, daily physical activity, history of diseases and health questionnaire, 30 of 70 subjects

were selected as available samples. Then, all participants completed individual consent and demographic information forms.

Inclusion criteria were willingness to participate in the research, BMI below 18.5 kg/m^2, age between 18 to 26 years, no regular exercise in the last year, avoiding the use of supplements and medications during the past six months and no history of chronic diseases including cardiovascular diseases. This research was approved by the ethic committee on human experiments in faculty of physical education and sport science of Guilan University.

Before eight weeks of training, some anthropometric and physical fitness characteristics including arm and thigh circumferences, upper-body muscular endurance (push-ups), upper-body strength (bench press), lower-body strength (leg press) and flexibility (sit-and-reach) were assessed in all participants.

Extremities perimeter

Tape measure was used to obtain round-arm and round-femur so that the tape was wrapped softly around the organs and no pressure was applied to the skin.

- Arm circumference measurement: while the palm was upward and upper limbs were kept directly in front of the body, the measurement was carried out at the mid-point between the shoulder and the elbow.
- Thigh circumference measurement: measurement part of the thigh was just below the buttocks.

Strength

Berzicky equation was used to calculate muscular strength in the resistance efforts. Subjects performed bench press and leg press exercises with an estimated weight up to eight repetitions; then by putting the number of repetitions in the mentioned equation, the value of 1RM was calculated. Bench press and leg press tests were used to assess upper-body and lower-body strength, respectively [14].

Muscular endurance

The push-ups test was used to measure muscular endurance. Participants kept their hands shoulder width apart, while a straight line was formed from toes to hips and shoulders, the upper-body was brought down and the elbows were bent about 90 degrees and again the body was lifted up. The subjects performed the test as much as possible and the examiner counted the number of repetitions.

Flexibility

The sit-and-reach test was used to measure flexibility, so that the participants were allowed to perform three replications and with 60 seconds of rest between them. Some of the conditions of this test include both knees should be locked and pressed flat to the floor, the legs are stretched and the soles of the feet have 90 degree angles. The test was carried out without doing stretching exercises beforehand.

Training protocol

After the initial test (pre-test), experimental groups trained for 8 weeks, 3 sessions per week for non-consecutive days and at the same time of the day; all exercises were carried out in two 10-repetition sets with slow speed and in circuit design. The rest interval was one or two minute(s) between the two exercises. The first 10 minutes of session was devoted to warm-up and the last 5 minutes of the session was devoted to stretching for cool-down. Before starting the program, two sessions were intended to familiarize the participants with the exercises.

TRX training protocol

The training program was a combination of exercises for large muscle groups and several motor plates. The TRX training program was performed using the TRX device related to suspension training system. The TRX device was mounted on a rod by connecting 2.44 meters above the ground. This allowed the participants to perform exercises directly below the connection point.

In general, progress in training levels for TRX group were as distance placed closer to the connection point, alter of two feet to one foot, and an increase in body angle to maintain intensity within the specified range. Dedicated intensity of advanced squat movements rose from two feet to one foot. Hamstring curl exercise progresses included further raising the thighs and buttocks in the form of bridge and bring both heels toward the buttocks. One unit increase to exert overload was considered every other weeks using the 10-rating Borg scale. Exercise intensities were in the range of 4-5 for the first fortnight using the Borg scale and based on increased load in the range of 5-6 during the second fortnight, 6-7 within the third fortnight and 7-8 during the fourth fortnight, respectively.

Traditional training protocol

The intensity of traditional resistance exercise protocol, equivalent to the Borg scale, was respectively as follows: for the first fortnight in the range of 60-65% of 1RM, and during the second fortnight based on the increasing load in the range of 65-70% of 1RM, within the third fortnight about 70-75% of 1RM and during the fourth fortnight about 75-80% of 1RM.

Statistical analyses

After testing normality of data using Shapiro-Wilk test, Intra-group changes were determined using Paired t-test. Additionally, ANOVA and Tukey's post hoc tests were used to determine differences among the three groups. For abnormal distributed data, nonparametric Wilcoxon test was used to assess intra-group differences and nonparametric Kruskal-Wallis test for the inter-group evaluation. Data were analysed using SPSS 16 software and the significance level was considered $p \leq 0.05$.

RESULTS

In total, 20 subjects (10 in traditional training group and 10 in TRX training group) completed the 8-week training period. As there were no significant changes in control group (without any training program) in any tested variable. There were significant improvements and strength (upper and lower body) in both traditional and TRX training groups. Both of training groups showed increased upper-body and lower-body strength after 8 weeks of training. The percentage of upper-body strength change in TRX group was significantly different from CT and RT groups. Post-test is significantly different from pre-test at $p<0.05$. Post-test is significantly different from pre-test at $p<0.01$. Change is significantly different from control group at $p<0.01$. Change is significantly different from other training group at $p<0.05$ (figure 1). Both of training groups showed increased muscular endurance after 8 weeks of training. The percentage of muscular endurance change in TRX group was significantly different from CT and RT groups, and TRX group showed higher improvement in muscular endurance. There was significant difference between RT and CT groups in the percentage of muscular endurance change. Post-test is significantly different from pre-test at $p<0.05$. Post-test is significantly different from pre-test at $p<0.01$.Change is significantly different from control group at $p<0.05$. Change is significantly different from control group at $p<0.01$. Change is significantly different from other training group at $p<0.05$ (figure 2).

No significant change in flexibility was observed among groups. In the inter-group comparison, upper-body strength and muscular endurance showed further significant increase in TRX group compared with traditional group. Neither of training groups showed significant change in extremities perimeter after 8 weeks of training. Non-significant inter-group differences were also observed in the percentage of changes (figure 3).

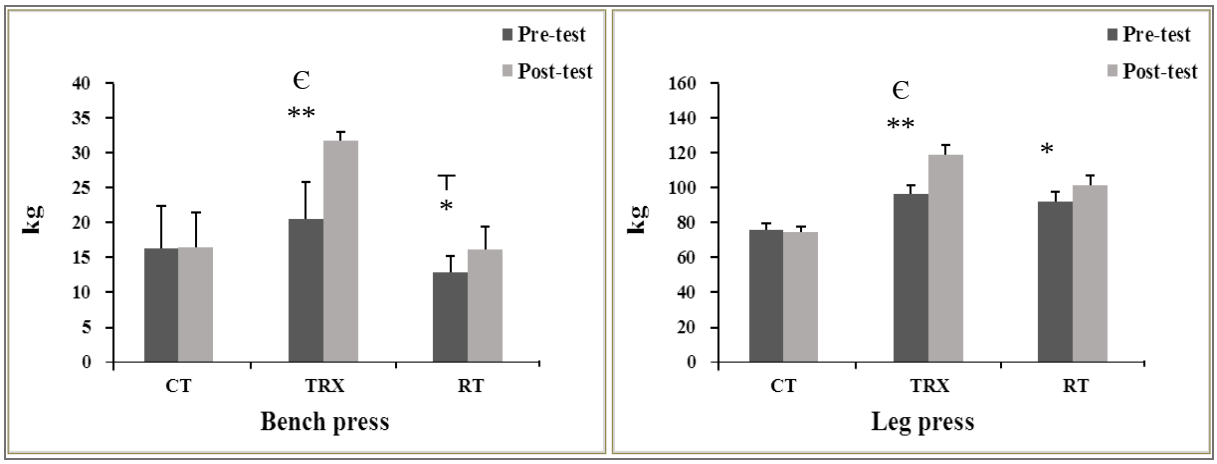

Figure 1. Comparison of upper-body and lower-body strength among TRX and RT groups. *Abbreviations are; CT: Control, RT: Traditional resistance training.*

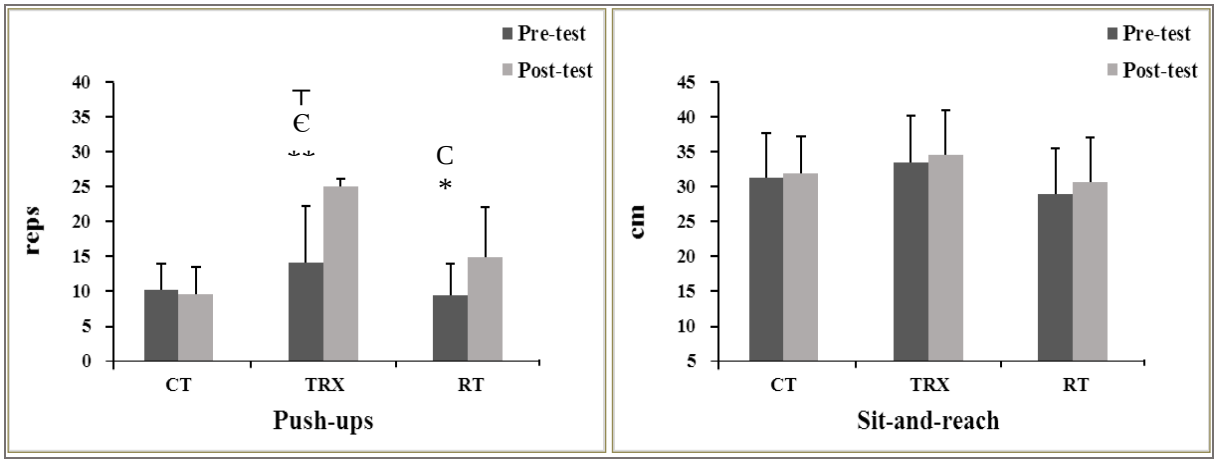

Figure 2. Comparison of muscular endurance and flexibility among TRX and RT groups. *Abbreviations are; CT: Control, RT: Traditional resistance training, reps: repetitions.*

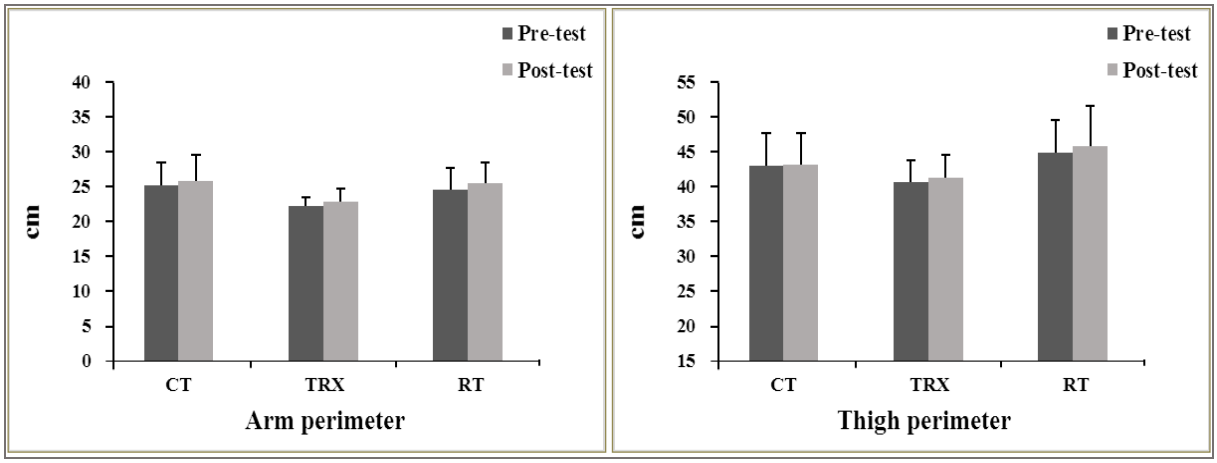

Figure 3. Comparison of thigh and arm perimeter among TRX and RT groups. *Abbreviations are; CT: Control, RT: Traditional resistance training.*

DISCUSSION

The findings of the present study showed that after eight weeks of resistance training with TRX and traditional methods, the upper- and lower-body strength had significant changes in both

traditional and TRX training groups. Dannelly et al. [11] reported increased upper-body strength after 13 weeks in both traditional and sling groups. Maté-Muñoz et al. [15] observed an increase in upper-body strength after seven weeks of resistance training in young men trained in both unstable and traditional training groups. Their result was in line with present study that could possibly justify elevated upper-body strength in both training groups. However, the present research demonstrated that TRX resulted in higher improvement in upper-body strength compared to traditional resistance training. Further, Janot et al. [12] found improved lower-body strength after seven weeks of TRX resistance training in middle-aged and youth groups.

The increase in muscular strength in this study is probably due to neural adaptations created during the eight weeks of training in underweight young girls. Since the nervous system is heavily involved in TRX training regarding the suspension condition, so neural adaptations justify the strength found in this study. Regularly, strength does not depend only on muscle mass, but nervous portion of motor units are also important. Thus, the strength increases in the early weeks of a strength training program, while there is no sign of muscle hypertrophy in this period.

In the present study, the changes in arm and thigh circumferences were considered as the criterion for muscular hypertrophy. According to the theory of neural adaptation, high muscular strength occurs rapidly in initial six to eight weeks of training, which is consistent with our results. On the other hand, minimal muscular hypertrophy due to strength training can be seen in six weeks, which may need more time to increase the muscle mass due to the impact of gender of subjects (low levels of testosterone and less muscle mass in females than in males) [16]. The results are in contrast with a research of Sayloret al. [2] which found significant improvement in lean body mass.

In this regard, one of the main theories is that the training in unstable conditions creates the same strength adaptation in lighter loads [17]. Similar strength responses caused by both kinds of training show that the body position and the instability generated by TRX had a similar effect to produce external load in resistance exercise. Increased strength observed arises largely due to neural adaptations caused by motor unit recruitment, frequency of excited motor units in addition to increasing motor unit recruitment or decreased neural inhibitors, and other neural factors including increased activity of facultative agonists and reducing antagonist performance. Many studies have investigated neuromuscular responses to exercise in suspension and stable positions. Capacity of recruiting motor units is very important. In fact, the muscle fibers that are not used during training cannot be stimulated to adapt. Byrne et al. [18] observed significant increase in EMG activity in the core, abdominal, thoracic and thigh muscles induced by TRX Plank in young adults.

The long-term increase in strength is usually associated with trained muscle hypertrophy. A lot of time is required to make proteins by reducing protein degradation and increased protein synthesis, or both. Apparently, neural factors have the greatest contribution within the 8 to 10 weeks of training. Supposedly, any increase in strength is under the influence of neural factors, but long-term strength increase is mainly due to hypertrophy. Probably, because the impact of gender of subjects, more time is needed to increase the volume of muscle mass [16]. Therefore, it is inferred that the eight-week resistance trainings at the suspension (TRX) and traditional manners may not have sufficient effect on muscular hypertrophy in underweight young girls.

Increased flexibility after a period of training was observed in both experimental groups, but not statistically significant, probably due to insufficient number of participants. Active and passive muscle stretching for warming-up in each training session is one of the causes of increased flexibility.

Flexibility is increased because of wide combination of movements in multiple plates, creating large range of motion. It is noteworthy that flexibility is considered neither clearly a fitness ability nor coordinator ability. However, it is a complex feature influences fitness and coordination abilities at the various performances. Flexibility is closely related to strength, endurance, speed and skill. The results of the present study about flexibility were in contrast to the findings of a study conducted by Weiss et al. [7] which reported further increase in flexibility for the participants in the functional training group compared to traditional group. On the other hand, Distefano et al. [19] observed similar changes in flexibility for participants involved in an integrated training program focused on core stability, strength, agility, and advanced resistance training. In general, these studies support the importance of functional trainings performed through all range of motion for increasing flexibility.

The involvement in resistance training professionally leads to decreased flexibility. But since the participants in this study had inactive lifestyle, traditional exercises have caused positive adaptations. However, improvement of flexibility compared to baseline state was non-significant.

Muscular endurance in both groups showed significant improvement due to effects of eight weeks of traditional and TRX trainings, indicating the effects of both training programs on the improvement of shoulder girdle muscular endurance. However, TRX caused higher improvement in muscular endurance. In this context, Dannelly et al. [11] observed significant improvement in muscular endurance in closed chain exercises at the end of training; but unlike the present study, no changes were observed in open chain exercises.

It seems that since the participants in this study had inactive lifestyle with low primary muscular endurance, traditional and TRX resistance training led to more activation of muscles and improvement of muscular endurance compared to baseline. Increased muscular endurance of shoulder girdle may be due to local muscular adaptations caused by increased oxidative enzymes activities such as succinate dehydrogenase (SDH), cytochrome oxidase and glycolytic enzymes like phosphorylase and phosphofructokinase [16]. Additionally, increasing the amount of glycogen is one of the dramatic changes in muscle during training period. The muscle trained for endurance tends to increase its glycogen stores and possible changes in these reserves may be effective in changing muscular endurance [16]. The problem referring to the influence TRX presented in this work, makes a part of complex problematics that can be specified as reflection about alternative model of traditional training [20]. The development of this aspect makes a part of interdisciplinary papers [21,22].

CONCLUSION

The goal of the present study was to compare the effects of eight weeks of TRX versus traditional resistance training on physical fitness factors and extremities perimeter of non-athlete underweight girls. Based on the results of this research, underweight non-athlete girls could benefit from TRX training as an alternative model of traditional resistance training and even a resistance training module with some possible advantages compared to traditional type with diversity in form and structure to gain muscular strength and endurance in addition to nutritional considerations. However, the present research had some limitations such as short-term protocol and few numbers of subjects. Hence, a further is recommended to be done on larger numbers of participants with a longer period design in order to clarify the impacts of TRX compared to traditional resistance training on structural and functional adaptations of muscular system during long-period training. For feature studies, it is also recommended to use electromyography to assure neurophysiological alterations are induced by TRX versus traditional resistance training within a same period of time.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants who volunteered to engage in this research. The authors report no conflict of interests.

REFERENCES

1. Fleck SJ, Kraemer W. Designing Resistance Training Programs, 4E. Human Kinetics, 2014.
2. Saylor SM. Efficacy of whole-body suspension training on enhancing functional movement abilities following a supervised or home-based 8-week training program 2016 (Doctoral dissertation, Cleveland State University).
3. Anderson K, Behm DG. The impact of instability resistance training on balance and stability, Sports Medicine 2005; 35(1): 43-53.
4. Mühlberg W, Sieber C. Sarcopenia and frailty in geriatric patients: implications for training and prevention, Zeitschrift für Gerontologie und Geriatrie 2004; 37(1): 2-8.

5. Dudgeon WD, Herron JM, Aartun JA et al. Physiologic and metabolic effects of a suspensión training workout, International Journal of Sports Science 2015; 5(2): 65-72. doi: 10.5923/j.sports.20150502.04
6. Behm DG, Drinkwater EJ, Willardson JM et al. Canadian Society for Exercise Physiology position stand: The use of instability to train the core in athletic and nonathletic conditioning, Applied Physiology, Nutrition, and Metabolism 2010; 35(1): 109-112. doi: 10.1139/H09-128
7. Weiss T, Kreitinger J, Wilde H et al. Effect of functional resistance training on muscular fitness outcomes in young adults, Journal of Exercise Science & Fitness 2010; 8(2): 113-122. doi: https://doi.org/10.1016/S1728-869X(10)60017-2
8. Snarr RL, Esco MR. Comparison of electromyographic activity when performing an inverted row with and without a suspension device, Age (yrs) 2013; 26(4.2): 22-3.
9. Gentil P, Oliveira E, Bottaro M. Time under tension and blood lactate response during four different resistance training methods, Journal of Physiological Anthropology and Applied Human Science 2006; 25(5): 339-344.
10. Wernbom M, Augustsson J, Raastad T. Ischemic strength training: a low-load alternative to heavy resistance exercise? Scandinavian Journal of Medicine & Science in Sports 2008; 18(4): 401-416.
11. Dannelly BD, Otey SC, Croy T et al. The effectiveness of traditional and sling exercise strength training in women, The Journal of Strength & Conditioning Research 2011; 25(2): 464-471.
12. Janot J, Heltne T, Welles C et al. Effects of TRX versus traditional resistance training programs on measures of muscular performance in adults, Journal of Fitness Research 2013; 2(2): 23-28.
13. Borg G. Perceived exertion as an indicator of somatic stress, Scandinavian Journal of Rehabilitation Medicine 1970; 2(2): 92-98.
14. Brzycki M. Strength testing—predicting a one-rep max from reps-to-fatigue, Journal of Physical Education, Recreation & Dance 1993; 64(1): 88-90.
15. Mate-Munoz JL, Monroy AJ, Jodra Jimenez P et al. Effects of instability versus traditional resistance training on strength, power and velocity in untrained men, Journal of Sports Science and Medicine 2014; 13(3): 460-468.
16. Costill DL, Wilmore JH, Kenney WL. Physiology of sport and exercise. Human Kinetics, 2008.
17. Behm DG, Anderson K, Curnew RS. Muscle force and activation under stable and unstable conditions, The Journal of Strength & Conditioning Research 2002; 16(3): 416-22.
18. Byrne JM, Bishop NS, Caines AM et al. Effect of using a suspension training system on muscle activation during the performance of a front plank exercise, The Journal of Strength & Conditioning Research 2014; 28(11): 3049-55. doi: 10.1519/JSC.0000000000000510
19. Distefano LJ, Distefano MJ, Frank BS et al. Comparison of integrated and isolated training on performance measures and neuromuscular control, The Journal of Strength & Conditioning Research 2013; 27(4): 1083-90. doi: 10.1519/JSC.0b013e318280d40b
20. Wasik J, Wojcik A. Health in the context of martial arts practice, Physical Activity Review 2017; 5: 91–94. doi: 10.16926/par.2017.05.013
21. Ortenburger D, Wasik J, Gora T. Report of the 1st World Congress on Health and Martial Arts in Interdisciplinary Approach 17-19 September 2015. Physical Activity Review 2015; 3: 49-51. doi: 10.16926/par.2015.05.07
22. Wasik J, Ortenburger D, Gora T. The kinematic effects of taekwondo strokes in various conditions the outside environment. Interpretation in the psychological aspect and perspective of application in sport, health-related training and survival abilities. Archives of Budo 2016; 12: 287-292