Теорія та методика фізичного виховання
Physical Education Theory and Methodology
Teorìâ ta Metodika Fìzičnogo Vihovannâ

ISSN 1993-7989 (print)
ISSN 1993-7997 (online)
ISSN-L 1993-7989

ORIGINAL SCIENTIFIC ARTICLE

EIGHT-WEEK FUNCTIONAL TRAINING WITH ASCENDING AMRAP MODEL AND FOR TIME CONSTANT LOAD MODEL TO INCREASE ABDOMINAL MUSCLE STRENGTH AND MAXIMAL OXYGEN CONSUMPTION LEVELS IN ADOLESCENT MALES

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Accepted for Publication: July 11, 2022
Published: September 23, 2022

DOI: 10.17309/tmfv.2022.3.10

Abstract

The study purpose was to investigate the effect of functional training with the ascending AMRAP model and with the FOR TIME constant load model on increasing abdominal muscle strength and maximal oxygen consumption (VO_2max) in adolescent males.

Materials and methods. This study used the True-Experimental method with the research design of the Randomized Control Group Pretest-Posttest Design. A total of 21 adolescent males aged 18-21, body mass index (BMI) 18.5-24.9 kg/m^2, normal blood pressure, normal resting heart rate, normal oxygen saturation (SpO_2) participated in this study and were divided into three groups, namely CTRLG (n = 7; control group), FSTAG (n = 7; ascending AMRAP functional training group), and FSTFG (n = 7; FOR TIME constant load functional training group). Both the ascending AMRAP functional training and the FOR TIME constant load functional training interventions were carried out with a frequency of 3 times/week for 8 weeks. Statistical analysis used the one-way ANOVA test with the Statistical Package for Social Science (SPSS) software version 21.

Results. The results showed that there was a significant difference in the mean delta (Δ) increase in abdominal muscle strength ($p \leq 0.05$). The mean delta (Δ) increase in VO_2max also showed a significant difference ($p \leq 0.05$).

Conclusions. Based on the results of the study, it was shown that the administration of functional training intervention with the ascending AMRAP model and functional training intervention with the FOR TIME constant load model which was carried out 3 times/week for 8 weeks increased abdominal muscle strength and maximal oxygen consumption levels.

Keywords: ascending AMRAP, FOR TIME constant load, abdominal muscle strength, VO_2max.

Introduction

Lack of physical activity can have serious implications for human health. Approximately 2 million deaths per year are associated with a lack of physical activity, prompting the WHO to issue a warning that an inactive lifestyle can be one of the top 10 causes of death and disability in the world (WHO, 2002). Sedentary behavior has wide-ranging adverse effects on the human body including an increase in all-cause mortality, such as death from cardiovascular disease, cancer risk, and the risk of metabolic disorders such as diabetes mellitus, hypertension, and dyslipidemia, musculoskeletal disorders such as arthralgia and osteoporosis, as well as depression, and cardiovascular disorders. cognitive (Park et al., 2020). Physical fitness is one of the strongest predictors of a person's health status (Artero et al., 2012; Kodama et al., 2009). In addition, physical fitness is a prerequisite in achieving one's peak performance. Physical fitness is characterized by the ability to perform and maintain activities of daily living and exhibit traits or capacities associated with a low risk of early development of movement-related diseases and conditions (Winnick & Short, 2005). Physical fitness refers to the components of physical fitness related to health that are influenced by habits in physical activity, including cardiovascular endurance, muscle strength and endurance, body composition, and flexibility (Dunn & Leitschuh, 2006).

Balance and posture are important for most human movements (Winter, 1990). Postural control or balance can be defined statically as the ability to maintain a base of support with minimal movement and dynamically as the ability to perform tasks while maintaining a stable position (Bressel, 2007). The main factor that affects balance is the function of skeletal muscles as an active means of movement, especially abdominal muscles (Örgün et al., 2019; Akuthota & Fredericson, 2008). This is because the abdominal muscles connect the upper body with the lower body, the level of abdominal muscle strength is very influential on the balance of the body. Core exercise is a popular term in athletics and rehabilitation fields (Örgün et al., 2019; Mok et al., 2015; Jamison et al., 2012; Hibbs et al., 2008). Low muscle mass (i.e. sarcopenia) can be defined as an age-related loss of lean tissue mass that usually results in decreased physical function, muscle strength, and mobility (Yang et al., 2018; Gray & Binns, 2016). An increase in muscle size is considered to be mechanically important for an increase in muscle function (Loenneke et al., 2019). Skeletal muscle plasticity is defined and characterized by dynamic functional and structural remodeling of muscle fibers (biochemistry and size). Changes can occur due to transfer of force loads (space travel, rear leg suspension, and bed rest) or due to increased load-bearing loads. Again, significant changes in the biochemistry of skeletal muscle fibers may occur as a result of high loads and high volume resistance training and low volume aerobic loads, thereby increasing oxidative capacity in certain subsets of the population. However, the exact contribution mechanism is uncertain (Khan, 2004). Physical fitness is currently considered to be one of the most important markers of health, as well as a predictor of morbidity and mortality from cardiovascular disease and other causes (Esmaeilzadeh & Ebadollahzadeh, 2012; Ortega et al., 2008). Cardiorespiratory fitness is positively related to cardiovascular health, academic achievement, and mental well-being in youth (Raghuveer et al., 2020).

Continuous and continuous development of physical condition training can improve athlete performance as well as an effort to advance Indonesian and international achievements. Through physical condition training programs, coaches can create additional training programs for athletes who have decreased physical condition and carry out advanced physical condition tests to achieve better physical conditions (Bompa, 2015). Achievement in every sport is something that is always a target to be achieved as much as possible. Therefore, it should be noted that in order to provide the best results in sporting achievements, it is necessary to establish achievement coaching in supporting the quality of professional athletes and coaches. This is because the coach must have the ability, including proper treatment related to physical conditions, techniques, tactics, and even psychology. Based on the above background, the purpose of this study was to prove the effect of functional training with the ascending AMRAP model and FOR TIME constant load on increasing abdominal muscle strength and maximal oxygen volume (VO_2max) in adolescent mens.

Materials and methods

Study participants

This study used the True-Experimental method with the research design of The Randomized Control Group Pretest-Posttest Design. A total of 21 teenage boys, aged 18-21 years, body mass index (BMI) 18.5-24.9 kg/m^2, normal blood pressure, normal resting heart rate, normal oxygen saturation (SpO2) participated in this study and divided into three groups, namely CTRLG (n = 7; control group), FSTAG (n = 7; functional training AMRAP ascending group), and FSTFG (n = 7; functional training FOR TIME constant load group). Prior to conducting the research, all subjects received information both orally and in writing about this research. All subjects filled out and signed informed consent before participating in the study.

Study organization

The training program is implemented and supervised by professional officers from the Department of Sports Coaching Education, Faculty of Sport Science, State University of Surabaya. The ascending AMRAP functional training intervention and the FOR TIME constant load functional training were carried out with a frequency of 3x/week for 8 weeks. Heart rate monitoring during ascending AMRAP functional training and FOR TIME constant load using Polar Heart Rate Monitor (Polar H10 Heart Rate Sensor, Inc., USA). This research was conducted at the International Youth Center Building, State University of Surabaya.

Body height was measured using a Stadiometer (Portable Seca® Stadiometer, North America), while body weight was measured using a digital scale (OMRON Model HN-289, Omron Co., Osaka, Japan). Body mass index (BMI) was measured by calculating body weight (kg) divided by TB (m^2). Blood pressure was measured using an OMRON digital blood pressure meter (OMRON Model HEM-7130 L, Omron Co., Osaka, Japan) on the non-dominant arm 3 times in a row with a 1-2 minute rest interval between the two measurements. At the time of measurement of blood pressure the subject is in a sitting position. Resting pulse rate and SpO_2 were measured using a Beurer Pulse Oximeter (PO 30 Pulse Oximeter). The measurement of abdominal muscle strength was carried out using the Sit Up test for 30 seconds, while the measurement of VO_2max used the Multistage Fitness Test (MFT). Abdominal muscle strength and VO_2max were measured pre-exercise and 8 weeks post-exercise.

Statistical analysis

Statistical analysis using software Statistical Package for Social Science (SPSS) version 21 (SPSS Inc., Chicago, IL, USA). Shapiro-Wilk was used to test for normality, while Levene's was used to test for homogeneity and the difference test used Paired Sample T-Test, One Way-ANOVA, followed by Tukey's Honestly Significant Difference (HSD) post hoc test. All data are displayed with Mean ± Standard Deviation (SD). All statistical analyzes used a significant level ($p \leq 0.05$).

Results

The results of the data analysis on the characteristics of the research subjects which included age, height, weight, body mass index, systolic blood pressure; diastolic blood pressure, resting heart rate, and oxygen saturation in each group are presented in Table 1.

Table 1. Results of data analysis on the characteristics of research subjects in each group

Parameter	n	Mean±SD			p -values
		CTRLG	FSTAG	FSTFG	
Age (years)	7	19.71 ± 1.11	19.57 ± 1.27	19.86 ± 1.07	0.899
Body Height (m)	7	1.69 ± 0.04	1.64 ± 0.03	1.68 ± 0.06	0.273
Body Weight (kg)	7	62.00 ± 5.89	59.43 ± 5.06	58.29 ± 3.82	0.382
Body Mass Index (kg/m^2)	7	21.78 ± 1.27	21.97 ± 1.67	20.69 ± 0.79	0.164
Systolic Blood Pressure (mmHg)	7	116.86 ± 3.08	112.86 ± 9.51	115.71 ± 5.35	0.513
Diastolic Blood Pressure (mmHg)	7	76.86 ± 3.08	75.71 ± 5.35	75.71 ± 5.35	0.873
Resting Heart Rate (bpm)	7	66.71 ± 4.11	63.71 ± 4.68	70.86 ± 9.99	0.171
Oxygen Saturation (%)	7	97.57 ± 1.27	97.43 ± 1.52	97.43 ± 1.52	0.977

Description: CTRLG: Control group; FSTAG: Functional training AMRAP ascending group; FSTFG: Functional training FOR TIME constant load group. p-value was obtained using the one-way ANOVA test. Data is displayed with Mean ± SD.

Based on Table 1, the results of the one-way ANOVA test showed that there was no significant difference in the data on the characteristics of the research subjects between the three groups ($p \leq 0.05$). The results of the analysis of the average abdominal muscle strength between pre-exercise vs. post-exercise in each group is presented in Figure 1.

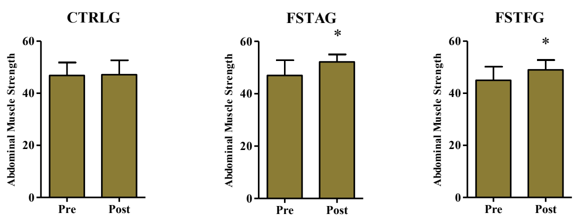

Fig. 1. Average abdominal muscle strength between pre-exercise vs. post-exercise in each group

Description: CTRLG: Control group; FSTAG: Functional training AMRAP ascending group; FSTFG: Functional training FOR TIME constant load group. p-Values were obtained by using the different Paired Samples t-Test. (*) Significant vs. pre-exercise ($p \leq 0.05$). Data is displayed with Mean ± SD.

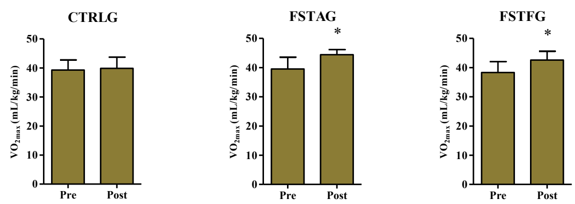

Fig. 2. Average VO_2max level between pre-exercise vs. post-exercise in each group

Description: CTRLG: Control group; FSTAG: Functional training AMRAP ascending group; FSTFG: Functional training FOR TIME constant load group. p-values were obtained by using the different Paired Samples t-Test. (*) Significant vs. pre-exercise ($p \leq 0.05$). Data is displayed with Mean ± SD.

Based on Figure 1, it can be seen that the average abdominal muscle strength in CTRLG has the same tendency between pre-exercise and post-exercise, while in FSTAG and FSTFG it has a tendency to increase. The results of the different Paired Samples t-Test showed that there was no significant difference in the average abdominal muscle strength between pre-exercise and post-exercise at CTRLG (46.86 ± 4.95 vs. 47.14 ± 5.49 repetitions, (p-values=0.356)). While the average abdominal muscle strength between pre-exercise and post-exercise on FSTAG showed a significant difference (47.00 ± 5.80 vs. 52.14 ± 2.85 repetitions, (p-values=0.007)). Likewise, the FSTFG showed a significant difference in the average abdominal muscle strength between pre-exercise and post-exercise (45.00 ± 5.20 vs. 49.00 ± 3.74 repetitions, (p-values=0.017)). The results of the analysis of the average VO_2max levels between pre-exercise vs. post-exercise in each group is presented in Figure 2.

Based on Figure 2, it can be seen that the average VO_2max levels in CTRLG has the same tendency between pre-exercise and post-exercise, while in FSTAG and FSTFG it has a tendency to increase. The results of the different Paired Samples t-Test showed that there was no significant difference in the mean VO_2max levels between pre-exercise and post-exercise at CTRLG (39.29 ± 3.46 vs. 39.86 ± 3.88 mL/kg/min, (p-values= 0.236)). Meanwhile, the mean VO_2max levels between pre-exercise and post-exercise at FSTAG showed a significant difference (39.54 ± 3.99 vs. 44.41 ± 1.77 mL/kg/min, (p-values=0.004)). Likewise, the FSTFG showed a significant difference in the mean VO_2max levels between pre-exercise and post-exercise (38.34 ± 3.68 vs. 42.59 ± 3.02 mL/kg/min, (p-values=0.001)).

Based on Table 1, the results of the one-way ANOVA analysis showed that there was no significant difference in the mean pre-exercise and post-exercise muscle strength between the three groups ($p \geq 0.05$), while the delta mean (Δ) abdominal muscle strength showed a difference. significant ($p \leq 0.05$). The results of the Tukey's Honest Significant Difference (HSD) post-hoc test showed that there was a significant difference in average delta (Δ) muscle strength between FSTAG and CTRLG (p-values=0.011), FSTFG and CTRLG (p-values=0.043), while FSTAG and FSTFG did not show any significant difference ($p \geq 0.05$).

Based on Table 1, the results of the one-way ANOVA analysis showed that there was no significant difference in the mean VO_2max pre-exercise between the three groups ($p \geq 0.05$), while the average VO_2max post-exercise and delta (Δ) showed a significant difference ($p \leq 0.05$). The results of the Tukey's Honest Significant Difference (HSD) post-

Table 2. The results of the analysis of Abdominal Muscle Strength and VO_2max between the three groups

Parameter	n	Mean±SD			p-values
		CTRLG	FSTAG	FSTFG	
Abdominal Muscle Strength (Repetitions)					
Pre-exercise	7	46.86 ± 4.95	47.00 ± 5.80	45.00 ± 5.20	0.739
Post-exercise	7	47.14 ± 5.49	52.14 ± 2.85	49.00 ± 3.74	0.105
Delta (Δ)	7	0.29 ± 0.76	5.14 ± 3.44*	4.00 ± 3.21*	0.010
VO_2max (mL/kg/min)					
Pre-exercise	7	39.29 ± 3.46	39.54 ± 3.99	38.34 ± 3.68	0.819
Post-exercise	7	39.86 ± 3.88	44.41 ± 1.77*	42.59 ± 3.02	0.035
Delta (Δ)	7	0.57 ± 1.15	4.87 ± 2.88*	4.24 ± 1.73*	0.002

Description: CTRLG: Control group; FSTAG: Functional training AMRAP ascending group; FSTFG: Functional training FOR TIME constant load group. p-Values were obtained using the one-way ANOVA test followed by Tukey's Honestly Significant Difference (HSD) post hoc test. (*) Significant vs. CTRLG ($p \leq 0.05$). Data is displayed with Mean ± SD.

hoc test showed that there was a significant difference in the average VO_2max post-exercise FSTAG with CTRLG (p-values=0.029), while FSTFG with CTRLG, FSTAG and FSTFG did not show any significant difference ($p \geq 0.05$). The results of the Tukey's Honest Significant Difference (HSD) post-hoc test showed that there was a significant difference in the mean delta (Δ) VO_2max between FSTAG and CTRLG (p-values=0.003), FSTFG and CTRLG (p-values=0.009), while FSTAG and FSTFG did not show any significant difference ($p \geq 0.05$).

Discussion

Based on the research, it was shown that the functional training intervention with the AMRAP model of functional exercise and FOR TIME model which was carried out 3x/week for 8 weeks to increased abdominal muscle strength and maximum oxygen volume level on petanque athletes. The explanation given by Fathir et al. (2021) functional training with AMRAP, FOR TIME, and EMOM increases strength, endurance, and speed on runners. However, of the three types, functional exercise with For Time is better at increasing strength, endurance, and speed, than AMRAP and EMOM functional exercises. However, the AMRAP model of functional exercise was more effective in increased abdominal muscle strength and maximum oxygen volume level than FOR TIME model. Previous research on functional training with 21-minute AMRAP can develop agility and balance for young basketball athletes (Wibowo et al., 2020). This explanation confirms that functional training with 21-minute AMRAP was effective in improving several components of physical condition. Functional training was the development of an interval training model or intermittent because it has the benefit of increasing the biomotor components, namely strength, endurance, flexibility, balance, speed, and agility so that activities always involve more than 3 muscle groups and involve the core muscles (Wibowo et al., 2021). However, the components of the physical condition of abdominal strength and maximum oxygen volume levels could be proven in this study. Abdominal muscle strength was the ability of the abdominal muscles to perform movements in standing, sitting, and walking. That abdominal muscle strength was the energy used to change the state of motion or shape by using the muscles of the lower extremities and core from starting to moving, stopping depending on the physical nature of the object and the magnitude of the force, fulcrum and direction of force. Therefore in the petanque sport, good abdominal muscle strength was needed to support good physical condition. This could be achieved by giving the AMRAP model of functional training (Brooks & Copeland, 2012).

Based on the results of this study that the AMRAP model of the functional exercise was effective in increasing abdominal muscle strength and maximum oxygen volume levels on petanque athletes. The AMRAP model aims to achieve the highest number of repetitions or rounds during the task (de-Oliveira et al., 2021). The strength exercises in AMRAP, the practitioner who must complete the maximum number of repetitions/rounds in the established time could perform each exercise at the highest possible execution velocity since the first repetition. Thus, those for whom the different absolute loads (body mass or external resistance) assume a lower relative intensity, in theory, will complete each exercise in less time. Besides, depending on the velocity loss they reach over the set time, they will perform a higher number of repetitions/rounds in the pre-defined total time. In this way, the subject who could initially perform better would be the one who trains with less relative intensity, being able to perform the exercises at a higher velocity and possibly with a lesser velocity loss in the set, compared to those who perform the same number of repetitions with the same absolute load, which represents a higher relative intensity (Silva-Grigoletto et al., 2020). The AMRAP method could produce a significant increased in maximal aerobic capacity, an increased in maximal oxygen consumption expressed as a function of body mass was significantly correlated with an increased in absolute oxygen consumption. As was generally understood, an increased in relative VO_2max can result from an increased in absolute oxygen consumption. Therefore, the main factors that could cause an increase in the value of VO_2max are due to the AMRAP method and an increase in absolute oxygen consumption.

In the model FOR TIME, the exercises are performed with the same absolute load, and the established number of repetitions must be performed in the shortest possible time. In this way, the participants start each exercise with the same absolute load (except in the case of body mass), which will typically have different relative intensities. As the number of repetitions is established and fixed, the velocity loss for each subject may differ; therefore, the degree of fatigue achieved will be different in most cases. This variation in the character of effort made will mean that, in general, those who make a character of less effort will obtain a better result, which usually implies that the average velocity achieved will be higher, so that the average relative intensity will be lower in those who complete the rounds in less time. Once again, we are faced with a proposal that is impossible to know, with a certain degree of precision, the degree of effort developed by each participant (Silva-Grigoletto et al., 2020).

Based on the above discussion, the AMRAP model of functional training could be used as the right and effective type of exercise for petanque athletes in increasing abdominal muscle strength and maximum oxygen volume (VO_2max).

Conclusion

Ascending AMRAP model and functional training with the FOR TIME constant load model which was carried out 3x/week for 8 weeks increased abdominal muscle strength and maximum oxygen volume levels. However, functional training with the AMRAP model ascending is more effective in increasing abdominal muscle strength and maximum oxygen volume levels compared to functional training with the FOR TIME constant load model.

Conflicts of interest

The authors declare that they have no conflict of interest.

Acknowledgments

This research was supported by an internal research grant from the Faculty of Sports Science (Research Assignment Faculty of Sports Science), State University of Surabaya, Surabaya, Indonesia.

References

World Health Organization. (2002). *Physical inactivity a leading cause of disease and disability, warns WHO.* Retrieved January 18, 2022, from www.who.int: https://www.who.int/news/item/04-04-2002-physical-inactivity-a-leading-cause-of-disease-and-disability-warns-who#:~:text=Sedentary/lifestyles/increase/all/causes,lipid/disorders/depression/and/anxiety

Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean journal of family medicine, 41*(6), 365-373. https://doi.org/10.4082/kjfm.20.0165

Artero, E. G., Lee, D. C., Lavie, C. J., España-Romero, V., Sui, X., Church, T. S., & Blair, S. N. (2012). Effects of muscular strength on cardiovascular risk factors and prognosis. *Journal of cardiopulmonary rehabilitation and prevention, 32*(6), 351-358. https://doi.org/10.1097/HCR.0b013e3182642688

Kodama, S., Saito, K., Tanaka, S., Maki, M., Yachi, Y., Asumi, M., Sugawara, A., Totsuka, K., Shimano, H., Ohashi, Y., Yamada, N., & Sone, H. (2009). Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: a meta-analysis. J*AMA, 301*(19), 2024-2035. https://doi.org/10.1001/jama.2009.681

Winnick, P. W., & Short, F. X. (1999). T*he Brockport physical fitness test manual.* Champagn, IL: Human Kinetics.

Dunn, J. M., & Leitschuh, C. A. (2006). *Special Physical Education* (8th ed.). Dubuque, Iowa: Kendall/Hunt.

Winter, D. A., Patla, A. E., & Frank, J. S. (1990). Assessment of balance control in humans. *Medical progress through technology, 16*(1-2), 31-51.

Bressel, E., Yonker, J. C., Kras, J., & Heath, E. M. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of athletic training, 42*(1), 42.

Örgün, E., Kurt, C., & Özsu, İ. (2019). The effect of static and dynamic core exercises on dynamic balance, spinal stability, and hip mobility in female office workers. *Turkish journal of physical medicine and rehabilitation, 66*(3), 271-280. https://doi.org/10.5606/tftrd.2020.4317

Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2008). Core stability exercise principles. *Current sports medicine reports, 7*(1), 39-44. https://doi.org/10.1097/01.CSMR.0000308663.13278.69

Mok, N. W., Yeung, E. W., Cho, J. C., Hui, S. C., Liu, K. C., & Pang, C. H. (2015). Core muscle activity during suspension exercises. *Journal of Science and Medicine in Sport, 18*(2), 189-194. https://doi.org/10.1016/j.jsams.2014.01.002

Jamison, S. T., Mcneilan, R. J., Young, G. S., Givens, D. L., Best, T. M., & Chaudhari, A. M. W. (2012). Randomized Controlled Trial of the Effects of a Trunk Stabilization Program on Trunk Control and Knee Loading. *Medicine & Science in Sports & Exercise, 44*(10), 1924-1934. https://doi.org/10.1249/MSS.0b013e31825a2f61

Hibbs, A. E., Thompson, K. G., French, D., Wrigley, A., & Spears, I. (2008). Optimizing Performance by Improving Core Stability and Core Strength: *Sports Medicine, 38*(12), 995-1008. https://doi.org/10.2165/00007256-200838120-00004

Yang, N. P., Hsu, N. W., Lin, C. H., Chen, H. C., Tsao, H. M., Lo, S. S., & Chou, P. (2018). Relationship between muscle strength and fall episodes among the elderly: the Yilan study, Taiwan. *BMC geriatrics, 18*(1), 90. https://doi.org/10.1186/s12877-018-0779-2

Gray, M., Glenn, J. M., & Binns, A. (2016). Predicting sarcopenia from functional measures among community-dwelling older adults. *AGE, 38*(1), 22. https://doi.org/10.1007/s11357-016-9887-0

Loenneke, J. P., Dankel, S. J., Bell, Z. W., Buckner, S. L., Mattocks, K. T., Jessee, M. B., & Abe, T. (2019). Is muscle growth a mechanism for increasing strength? *Medical hypotheses,* 125, 51-56. https://doi.org/10.1016/j.mehy.2019.02.030

Khan, Munna. (2004). Leg resistance training: Effects upon VO2 peak and skeletal muscle myoplasticity. *Journal of Exercise Physiology Online, 7*(5), 27-43.

Esmaeilzadeh, S., & Ebadollahzadeh, K. (2012). Physical fitness, physical activity and sedentary activities of 7 to 11 year old boys with different body mass indexes. *Asian journal of sports medicine, 3*(2), 105-112. https://doi.org/10.5812/asjsm.34709

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjöström, M. (2008). Physical fitness in childhood and adolescence: A powerful marker of health. *International Journal of Obesity, 32*(1), 1-11. https://doi.org/10.1038/sj.ijo.0803774

Raghuveer, Geetha & Hartz, Jacob & Lubans, David & Takken, T. & Wiltz, Jennifer & Mietus-Snyder, Michele & Perak, Amanda & Baker-Smith, Carissa & Pietris, Nicholas & Edwards, Nicholas (2020). Cardiorespiratory Fitness in Youth: An Important Marker of Health: A Scientific Statement From the American Heart Association. *Circulation, 142*(7). https://doi.org/10.1161/CIR.0000000000000866

Bompa, T.O., & Carlo Buzzichelli, C. (2015). *Periodization Training For Sports*. Isbn: 978-1-4504-6943-2

Fathir, L. W., Hartanto, S., & Kusnanik, N. W. (2021). Strength, endurance and speed development using functional strength training (FST) program for recreational runners performance. *Journal of Physical Education and Sport, 21*(4s), 2453-2457. https://doi.org/10.7752/jpes.2021.s4330

Wibowo, S., Fathir, L. W., Soetanto, H., Kusnanik, N. W., Nurhasan, & Muhammad, H. N. (2020). Agility and Balance Development Using Functional Training for Basketball Youth Athlete. *Advances in Social Science, Education and Humanities Research, Proceedings of the International Joint Conference on Arts and Humanities,* (491), 1346-1350

Wibowo, S., Nurhasan, Fathir, L. W., Ashadi, K., Hartoto, S., Ardha, M. A., & Kartiko, D. C. (2021). The effect of a short term high intensity functional strength training on strength. *Journal of Physical Education and Sport, 21*(4s), 2332-2336. https://doi.org/10.7752/jpes.2021.s4312

Brooks, D. M., & Copeland, C. (2012). *Bosu Balance Trainer Integrated Balance Training*. USA.

de-Oliveira, L. A., Heredia-Elvar, J. R., Maté-Muñoz, J. L., García-Manso, J. M., Aragão-Santos, J. C., & Da Silva-Grigoletto, M. E. (2021). Analysis of Pacing Strategies in AMRAP, EMOM, and FOR TIME Training Models during "Cross" Modalities. *Sports, 9*(11), 144. https://doi.org/10.3390/sports9110144

Silva-Grigoletto, M.E.D., Heredia-Elvar, J.R., & Oliveira, L.A.de. (2020). "Cross" modalities: Are the AMRAP, RFT and EMOM models applicable to health? *Revista Brasileira de Cineantropometria & Desempenho Humano,* 22, e75400. https://doi.org/10.1590/1980-0037.2020v22e75400

ВОСЬМИТИЖНЕВЕ ФУНКЦІОНАЛЬНЕ ТРЕНУВАННЯ ЗА МОДЕЛЯМИ ЗМІННОЇ ТА СТАНДАРТНОЇ ВПРАВИ ДЛЯ ЗБІЛЬШЕННЯ СИЛИ М'ЯЗІВ ЧЕРЕВНОГО ПРЕСА ТА ПІДВИЩЕННЯ РІВНІВ МАКСИМАЛЬНОГО СПОЖИВАННЯ КИСНЮ В ЮНАКІВ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 2 табл., 2 рис., 26 джерел.

Метою дослідження було вивчення впливу функціонального тренування за моделями змінної та стандартної вправи на збільшення сили м'язів черевного преса та підвищення рівнів максимального споживання кисню (VO_2max) у юнаків.

Матеріали та методи. У цьому дослідженні використовували метод істинного експерименту з планом дворазового попереднього та підсумкового тестування для двох рандомізованих груп із контрольною групою. У дослідженні брали участь загалом 21 юнак віком 18-21 рік, індекс маси тіла (ІМТ) 18,5-24,9 кг/м^2, нормальний кров'яний тиск, нормальна ЧСС у стані спокою, нормальне насичення артеріальної крові киснем (SpO_2), яких розділили на три групи, а саме: CTRLG (n = 7; контрольна група), FSTAG (n = 7; група функціонального тренування за моделлю «Виконати якомога більше раундів вправ за заданий час зі збільшенням кількості повторів у кожному наступному раунді») та FSTFG (n = 7; група функціонального тренування за моделлю «Виконати заданий обсяг вправ якомога швидше з постійним навантаженням»). Інтервенційні функціональні тренування за моделлю «Виконати якомога більше раундів вправ за заданий час зі збільшенням кількості повторів у кожному наступному раунді» та за моделлю «Виконати заданий обсяг вправ якомога швидше з постійним навантаженням» проводили з частотою 3 рази на тиждень протягом 8 тижнів. Для статистичного аналізу даних використовували однофакторний дисперсійний аналіз із застосуванням ПЗ Statistical Package for Social Science (SPSS) версії 21.

Результати. Результати показали наявність статистично значущої різниці в середньому значенні дельти (Δ) збільшення сили м'язів черевного преса ($p \leq 0{,}05$). Середнє значення дельти (Δ) підвищення рівнів VO_2max також показало статистично значущу різницю ($p \leq 0{,}05$).

Висновки. На підставі результатів дослідження було показано, що призначення інтервенційного функціонального тренування за моделлю «Виконати якомога більше раундів вправ за заданий час зі збільшенням кількості повторів у кожному наступному раунді» та за моделлю «Виконати заданий обсяг вправ якомога швидше з постійним навантаженням», яке проводили 3 рази на тиждень протягом 8 тижнів, забезпечило збільшення сили м'язів черевного преса та підвищення рівнів максимального споживання кисню.

Ключові слова: метод змінної вправи, метод стандартної вправи, сила м'язів черевного преса, максимальне споживання кисню (VO_2max).

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Cite this article as: Hafidz, A., Prianto, D.A., & Hidayat, T. (2022). Eight-Week Functional Training with Ascending AMRAP Model and FOR TIME Constant Load Model to Increase Abdominal Muscle Strength and Maximal Oxygen Consumption Levels in Adolescent Males. *Physical Education Theory and Methodology, 22*(3), 366-372. https://doi.org/10.17309/tmfv.2022.3.10

Received: 13.02.2022. Accepted: 11.07.2022. Published: 23.09.2022