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## The effect of a short term high intensity functional strength training on strength and endurance in recreational runners

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### Abstract:

Functional training is the development of an interval training model / intermittent because it has the benefit of increasing the biomotor components, namely strength, endurance, flexibility, balance, speed, agility so that activities always involve more than 3 muscle groups and involve the core muscles. This study notes that functional training with the high intensity interval training method improves the strength and endurance cardiovascular of recreational runners performance. The purpose of this study was to analyze the effect of functional strength training on strength and endurance. This study involved that 24 male volunteers aged 25-40 years old, where have an experimental groups were taken randomly, namely the treatment group is AMRAP (n = 12) and the other group is control (n = 12). The Amrap (AG) group was given an exercise program for 30 minutes ascending load with 30-50% 1 RM and moderate to high intensity (70-90%) HRMax using Skier, Airbike, Barbell and TRX equipments for a short-term in 6 weeks (3 times a week). Pre and Post test using leg dynamometer to measure the strength of the leg muscles and endurance tests by performing a Balked test and a speed test by running 20 meters. The author analyzes the scientific literature and methodology with quantitative research methods Independent T-test and one-way ANOVA were conducted to compare strength and cardiovascular endurance between groups. The results showed that the AG group with 30-50% 1 RM of 70-90% Maximum heart rate within 30 minutes showed a significant ( $p > 0.05$ ) strength and significant ( $p > 0.05$ ) increase in endurance cardiovascular. The findings that can be underlined are the importance of the 6-week AMRAP high intensity functional training (HIFT) model with 30-50% 1 RM of 70-90% Maximum heart rate within 30 minutes can increase strength and endurance cardiovascular in recreational runners.

**Key Words:** Functional Training, strength, endurance.

### Introduction

Athletics is the mother of sports. Athletics can be done by all ages and genders and does not require relatively expensive costs, this sport is one of the most popular sports in the world (F. Garcia-Pinillos et al., 2015). A runner usually has goals: (1) to improve their athletic performance and (2) a healthy and active lifestyle. In the program to improve running performance, it can be done with weight training (static or dynamic) where this is done to reduce the risk of injury to bones, joints, ligaments and muscles. Several exercise programs to improve running performance including functional training (FT) are very much favored by runners in practice and are considered a better alternative compared to increasing muscle strength, power, speed, cardiovascular endurance, muscle endurance, coordination and stamina. The study was conducted to determine the effect of functional training compared to conventional training, both with a duration of five consecutive weeks and a frequency of three times a week, on anthropometric variables, explosive strength in adolescents.

The authors concluded that training is most indicated for improving postural control and coordination. Recently (Srikanthan et al., 2016) studied the physiological and metabolic responses of a person who maintains his heart health by running and found that a program that is carried out in a programmed and measurable manner can increase his fitness level as well as maintaining the body's immunity this is also clarified by the American College of Sports Medicine (Liu et al., 2017). Furthermore, (Doma & Deakin, 2013) found that both FT and resistance were beneficial for improving the fitness components of a runner, namely endurance, balance, and muscle strength carried out for seven weeks in healthy and fit runners. High functional training (HIFT) has the basis for activating several muscle groups and has a major influence on the achievement of fitness results from teenagers to the elderly, so that not only athletes or people who work in the military can access this functional training exercise, but also everyone in the military generally (Poston et al., 2017). The HIFT program is growing very rapidly across the country and it is becoming a necessity for everyone. But it also needs to be mastered by someone who makes this functional training a physical necessity in improving running

performance. With this research, it will be an additional reference for coaches, runners and also all groups in improving running performance by doing functional training exercises.

(Feito et al., 2018) showed the results of resistance training can effectively increase strength in runners followed by an increase in cardiovascular endurance and metabolic function of the heart and skeletal muscles (Fothergill et al., 2017) by doing a consistent, programmed and structured exercise not only on an athlete's training program, but also people who have a penchant for running with most of their time prepared for light-to-moderate and high-intensity training (Yüksel et al., 2028). Functional exercise is an exercise modality that emphasizes the functional movement of the body, with multi-joint movements that can be modified from beginners to trained so that a person gets many benefits from doing it, including activating muscle groups that affect running performance (Casemiro et al., 2017). Functional strength training exercises using the interval circuit training method are often compared to high-intensity interval training (HIIT), but the two are different because the training zones using the HIIT method are included in the heavy activity category of 80-100% HRMax which is repeated in a relatively short time, then interspersed with periods of rest or low-intensity exercise for recovery (Zaton & Michalik, 2015), functional exercise that continuously varies, including the principle of exercise for a person not to get bored easily during physical exercise as well as evaluating the effectiveness of functional programs with the interval method in power adaptation, cardiorespiratory endurance, strength and speed (Inovero & Pagaduan, 2015).

The purpose of this paper is to provide a working definition of functional exercise and review the existing literature on improving running performance, especially on the components of physical strength, cardiorespiratory endurance and speed and reducing the risk of significant injury (Falatic et al., 2015). The annual incidence of running-related injuries is high, occurring in 40% to 50% of runners (Felipe Garcia-Pinillos et al., 2017). Although it is widely accepted that injuries in endurance runners are multifactorial, it is also recognized that running-related injuries are often caused by training errors. . due to the lack of studies evaluating the incidence of injury, the effect of heavy running on markers associated with injury risk remains unknown, so this review focuses primarily on the effects of functional training on performance of muscle strength, cardiovascular endurance and speed (Robertson-Wilson & Fortier, 2017). The purpose of this study was to analyze the functional exercise program in terms of endurance and strength test results. Therefore, research will be carried out on functional training exercises to help increase strength and endurance in recreational runners effectively and efficiently by using dynamic weights that can be done together in a relatively short time for 30-45 minutes (Bompa & Buzzichelli, 2015). This effort is expected to increase the strength and endurance of recreational runners for 6 weeks so that the objectives of this study can be achieved and can be further developed in further research.

## Material & methods

This study was an experimental study using a randomized controlled design model used to assess the effect of functional exercise on cardiovascular endurance and strength outcomes. Subjects in this study were randomly assigned to determine the group with functional exercise (FG) and the control group (CG). The functional exercise group (FG) was given a high-intensity functional exercise model using dumbbells (DB) and kettlebells (KB) as much as possible (AMRAP) with 3 rounds of 50% 1RM; 8 Deadlift, 8 CMJ Barbell, 8 DB Devil Press, 8 KB Swing, 8 KB Turkish Get Up, 8 KB Deadbug within 30 minutes, three times a week for up to 6 weeks. The control group performed normal daily activities. After 6 weeks, cardiovascular endurance and strength tests will be carried out in both groups to see the improvement in the stage 1 test and the test after a 6-week experiment on twenty-four participants who were divided into 2 groups, namely FG and CG (Table 1). The study took place between February and March 2021.

**Table 1.** Baseline characteristics of participants. \*

	CG (n= 12)	FG (n= 12)	t
Age (y)	25.49 0.98	27.50 0.95	-2.19
Height (cm)	175.77 9.03	176.56 6.20	-2.79
Weight (kg)	71.45 6.77	72.83 10.22	-2.38
Body mass index (kg. m <sup>-2</sup> )	22.82 4.51	22.85 4.15	-0.03
Visceral Fat	4 9.33	5 9.11	-1

The two groups, FG and CG in table 1 show that there is a relatively equal age range of 5 years with the same sex (male) and has an ideal body mass index and has no history of risky injuries such as heart failure, kidney, fractures and others. etc.

## Statistical Analyses

This study uses the spss application for windows (version 20) t-test to assess the results of differences between the two groups. Factorial analysis of variance to analyze the results of the influence of 2 groups (control

and experiment) on the results of the pretest and posttest cardiovascular endurance and strength of the FG and CG groups and to determine where the differences occur. The level of significance was set at  $p < 0.05$  for all tests.

## Results

The results of this study indicate that there is a significant effect of the results of pre and post test data during 6-week treatment for the functional training group as seen from tables 1 and 2, besides that the results show that there is no significant difference between the two groups (Table 1). The treatment implementers were 24 people who completed at least 90% of the sessions and the remaining 11 participants completed 100% of the sessions. In the findings of this study, FG with the high intensity method can increase cardiovascular endurance and physiological function of each dependent variable, as shown from the results of cardiovascular endurance test data with the VO2max using the Balke Test and the results of a significant increase in muscle strength seen from post test results, minute ventilation, tidal volume, distance traveled in the balke test, in both groups, which showed a significant increase in the decrease in HIFT in both groups ( $p = 0.005$ ). EG showed better results in leg strength ( $p < 0.05$ ). Thus, these findings state that emom exercise is more effective in increasing strength for 6 weeks compared to the amrap method and the interval method using amrap (as many rounds as possible) is much better in increasing the results of cardiovascular endurance for 6 weeks. So, it can be said that these two programs are good in supporting the performance of recreational runners, but need to be studied more deeply related to the development of further research that can be reviewed on the results of other components of physical condition.

Table 1. Pre Test Results

Group	Var	Mean	Median	Min	max	Std dev	N	Depression Score	P-value
AMRAP	Strength	101,5	121,05	92,5	155,5				
	Endurance	48,31	52,11	48,13	56,37				
Control	Strength	100	113,05	92	145				
	Endurance	48,07	50,11	47,5	55,30				

Table 2. Score of normality pre test (Shapiro-Wilk)

Group	Var	Statistic	df	Sig.	Keterangan
AMRAP	Strength	0,956	12	0,849	Normal
	Endurance	0,947	12	0,789	Normal
Control	Strength	0,939	12	0,837	Normal
	Endurance	0,921	12	0,751	Normal

Based on the table above, it is known that the pre-test results in all groups have obtained a significance value greater than 0.05. From these results it can be concluded that the overall data from the pre test results in all groups are normally distributed. Furthermore, after it is known that the pre test data is normally distributed, then the post test data will be analysed.

Table 3. Post Test Description and Result

Group	Var	Mean	Median	Min	max
AMRAP	Strength	150,5	130,5	110,5	175,5
	Endurance	51,20	54,60	50,33	59,31
Control	Strength	110	115	95	145
	Endurance	49,71	51,32	48,57	54,19

The results showed good results and had a significant effect on improving strength and endurance. Functional training also has the effect of increasing the strength of the leg muscles, the involvement of muscles in movement is very important because the main thing is to help other organs in supporting one's body, especially the leg muscles. Whatever the movement, it certainly requires leg muscle strength. Correct posture when making movements is needed to avoid falls and wrong landings so as to prevent injury. Some parts of the leg muscles that will also be involved in the training process. This movement refers to the body's ability to maintain a body centre position and movement. Even strength can also increase the endurance cardiovascular function of the aerobic capacity, especially in the maximum aerobic capacity (lung).

## Discussion

The purpose of this discussion is to critically analyze the literature to determine how FT affects the cardiovascular endurance, strength and speed of a recreational runner in the short term. main finding of FT training is that there is good cardio endurance after 6 weeks of high-intensity training 3 times a week. On the other hand, the FT-based training program improves strength performance in terms of leg muscle strength and



increases it effectively in achieving maximum speed. Thus, in this finding, the investigators recommend heterogeneity according to protocols and procedures as in the 6-week study period. Furthermore, it can be analyzed further by looking at the physiological response of functional exercise in the short-term and long-term adaptation ranges.

#### Conclusions

This functional strength training program can be used for the short term to increase strength, cardiovascular endurance and strength not only in athletes but also in recreational runners with high intensity and relatively short time. Therefore, several studies also clarified that the effectiveness of functional-based exercise programs (at least a 4 week program, at least 2-4 times of exercise per week showed results in improving cardiovascular endurance and strength performance.

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