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Original Article

Short-term strength and conditioning program in-season for improving specific basketball athletes' performance using AMRAP, EMOM FOR TIME

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Abstract:
This study aims to (1) determine the results of Functional Strength Training (FST) As Many Rounds As Possible (AMRAP) training on the performance of leg strength, agility, and endurance cardiovascular, (2) determine the results of FST Every Minute on the Minute (EMOM) training on the performance of leg strength, agility, and endurance cardiovascular (3) Find out the results of FOR TIME training on the performance of leg strength, agility, and endurance cardiovascular (4) Find out the differences between AMRAP, EMOM, and FOR TIME training on the performance of leg strength, agility, and endurance cardiovascular. The population of this study was 186 male basketball student-athletes in Surabaya. The samples in this study were taken using random sampling so that following the rules and data sampling system, 36 male basketball student-athletes aged 15-17 years in the city of Surabaya were obtained. This research used a quasi-experimental method with a matching-only design research design with group division based on ordinal pairing applied to three groups with each group consisting of twelve peoples. The pre and post-test data collection procedure uses the leg dynamometer test instrument to collect leg strength data, shuttle run (seconds) test instrument to measure agility, and MFT/multi-stage fitness test (ml/kg/minute) to measure endurance cardiovascular. The treatment in this study was carried out for twelve weeks with a training frequency of three times a week with each group doing weight training using 8 functional training movement; deadlift, back squats, barbell clean and press, icky shuffle, skipping rope, devil press, slam ball throw, and sled push with training heart rate from moderate to high intensity 85-90% of HR Max, volume 40% from 1 RM using the Amrap method in group 1, the Emom method in group 2 and the For Time method in group 3. The research results in group 1 showed a significant increase of as much as 14% in leg strength, 6% in agility and 12% endurance cardiovascular ($t < 0.05$), group 2 experienced a significant increase of 11% in leg strength, 8% in agility and 12% in endurance cardiovascular ($t < 0.05$), group 3 experienced a significant increase in 10% in leg strength, 4% agility and 12% endurance cardiovascular ($t < 0.05$). The third group did not have significant differences caused (sig. > 0.05), The results of this research was significant progress on the performance in eight weeks, while the emom method provides better results in increasing agility and progress in endurance cardiovascular in the amrap and for time groups. There was a significant increase in the pre-test and post-test results of functional strength training with the AMRAP, EMOM, and FOR TIME models toward increasing leg strength, agility, and endurance cardiovascular for eight weeks. This training program can be used in season and has been proven to be effective in improving the performance of male basketball student-athletes. The results of the three groups did not have significant differences in influence because the results of the multivariate test analysis were signed. level > 0.05.
Key Words: **Strength, agility, endurance cardiovascular, AMRAP, EMOM, FOR TIME.**

Introduction

Basketball is a sport that requires training in physical condition; strength, endurance cardiovascular, power, agility, and speed. A training program will be able to maximize athlete performance results. The basketball training program consists of a physical condition training program, technical training, tactical training, and mental training for physical activities which are carried out regularly and in a planned manner involving all components of physical condition to achieve the goal of being healthy, fit and productive (Meszler, 2019). Sports performance is a very complex action and depends on multifactors (Stojanović, 2018). In the process of reaching peak performance, every athlete goes through a long process from training to competition. Likewise, it is stated that each requires rigorous and specific training for each event that leads to the highest peak of performance (Exos, 2019).

Fathir (2021), Wibowo (2020), Paes (2022), Georgievski (2021), and Wibowo (2021), argue that functional training is a model of weight training. Loads that can be used in functional training are kettlebells

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(Falatic, 2015), trx, vipr, bosu (Brooks, 2015), rope, dumbbells, barbells, sandball and many other accessories (Asher, 2015). Functional exercises are carried out by following basic human anatomical movements such as flexion of the elbow joint, abduction, and adduction of the upper and lower extremities. Feito (2018), Cassemiro (2017), and Yükse (2018) argue that functional training is an exercise to maintain fitness and the movements carried out can be dynamic and static. The advantage of functional training is that the training models can be varied and the loads used are not only internal loads (body weight) but also external loads (accessories). Sheykhlouvand (2022), Wibowo (2022), Inovero (2017), Scanlan (2018), Josef (2018) and Grassman (2010) argue that the progressive overload can be adjusted to a person's physical condition and fitness by carrying out test stages such as strength tests (upper extremities and lower extremities), muscle endurance tests, cardiovascular endurance tests, power, agility, balance, flexibility, speed, acceleration, and coordination.

Aschendorf (2018), Box (2019), Figueira, (2022), and Alsasua (2021) argue that basketball needs functional training because the movements of functional training are dynamic and involve not just one muscle but several muscle groups, so functional training will help in improving physical condition during the off-season and in-season/competition (Feito, 2018). It is characterized by multidirectional movements and intense activities such as jumping, running, scrambling, and changes of direction that resemble movements in a game of basketball, as well as technical skills such as catching, dribbling, shooting, and passing that can be performed using functional tools (Song, 2023). The physical biomotors needed in the sport of basketball are strength, speed, agility, endurance, and energy (Fathir, 2020). This physical biomotor can improve and maintain skills in playing basketball which must also be supported by consistent physical condition training and technical training, these are interrelated and each factor has a different way of developing it. Physical training is the basis for developing other factors related to development in training (Bompa, 2019).

Male student basketball athletes who compete in a competition have the weakness of lacking agility and endurance cardiovascular, seen from statistical results. When athletes often make mistake which is caused by fatigue when defending and attacking in each quarter (Brito, 2023). One effort to increase muscle strength, agility and cardiovascular endurance in male student basketball athletes during the competition season is by providing dynamic training and adjusting the intensity and volume of training. In previous research findings, there are various ways to help improve the performance of male student basketball athletes in the competitive season, by providing 150 minutes of training for one week up to the sixth week as quoted from the results of Wibowo's research (2020), by providing agility training followed by Medium intensity can have a positive impact on increasing the agility and cardiovascular endurance of basketball athletes by 6% on average in the treatment group with a functional training model using TRX, Bosu and Vipr media so that this can be used to help support athletes' performance in competition. Each athlete has their own advantages in achieving performance, but you need to know that the genetics of athletes are also different for each individual, seen from posture or anthropometry, the latest data seen in table 1 shows that athletes have an ideal body mass index, but the body shape and muscle mass of each athlete is different, whereas in the game of basketball, muscle endurance, muscle strength and flexibility are needed to be able to make fast, precise, dynamic movements, explosive power and good agility. This physical training program in season applies the interval training method using functional training equipment, especially for male basketball student-athletes aged 15-17 years which is carried out over 8 weeks with a training frequency of 3 times /week using the functional strength training (FST) as many rounds as possible (AMRAP), every minute on the minute (EMOM) and FORTIME interval training methods to improve physical strength, agility and cardiovascular endurance. Review by comparing various variables, research methods, and results of research that has been carried out previously.This problem is necessary to carry out research by providing a short-term training program to male student basketball athletes during the competition season to minimum sport injury ACL and Jumper knee that is adjusted to the right intensity and training heart rate of 85% with a volume of 40% from 1 RM every three times a week in eight weeks.

Material & methods

This research is an experimental study with three independent variables, namely the FST Amrap, Emom, and For time training models, and three related variables, namely strength, agility, and cardiovascular endurance, where sampling was carried out using a random sampling method from a total population of 186 students. The age range in this study was from students who took part in basketball at school as male student-athletes, namely 15-17 years with a weight and height of 163-170 cm and a body weight of 63-67 kg, divided into 3 groups (table 1). The sample grouping method uses the ordinal pairing method. The placement of samples in each group follows the letter "S" pattern, by sorting the pre-test results of all samples. Sample grouping from rank 1 on FST AMRAP, rank 2 on FST EMOM, rank 3 on FST FOR TIME, rank 4 in FST FOR TIME, and so on. Then every group have 12 peoples, from three group of functional strength training who will do interval training by doing 8 training models, namely deadlift, back squat, barbell clean and press, icky shuffle, skipping Rope, Devil press, slam ball throw, and sled push with intensity 85-90%, volume 40% 1 RM for 8 weeks of 3 times/ week. The pre and post-test data in this study were the results of a strength test using a leg dynamometer (kg) instrument, an

agility test using a shuttle run test instrument, and a cardiovascular endurance test using a multi-stage fitness test/ MFT (ml/kg/minute).

Table 1. Characteristics of participants.

	FST AMRAP (n = 12)	FST EMOM (n= 12)	FST FOR TIME (n=12)
Age (y)	15.14 1.45	15.50 1.63	15.21 0.35
Weight (kg)	68. 51 2.42	65.82 3.15	64.45 6.21
Height (cm	163.71 8.03	160.36 5.42	161.41 5.23
Visceral Fat	2 3.31	2 7.45	2 3.84
Body mass index (kg. m-2)	20,12 3.25	20, 15 3.21	20, 12 1.32

Participants perform 3 tests; Strength test using the leg dynamometer test (kg), agility test using the shuttle run test, and cardiovascular test using the multi-stage fitness test (ml/kg/minute).

Statistical Analyses

This research method uses a quantitative descriptive method by conducting an independent T-test and MANOVA to determine the results of increasing strength, agility, and endurance cardiovascular and determine differences every groups. In collecting descriptive data, results were obtained regarding the average, standard deviation, variance, maximum, and minimum values, as well as the percentage increase in strength, agility, and cardiovascular endurance test results. The description of the data in this study uses the SPSS application for the Mac Book Pro Series 21. Measurement of normality data test or distribution data uses the Shapiro- Wilks method (Rencher, 2002).

The normality test states that the data for the three dependent variables are normal if the significance in a statistical test is greater than 0.05 (Rencher, 2002) and then homogeneity data is taken. Researchers answered the hypothesis with the data processing flow for strength, agility, and cardiovascular endurance in each training group, namely FST AMRAP, FST EMOM, and FST FOR TIME, here is the explanation: hypothesis at ($\alpha >$ 0.05) and whether there are differences in influence through MANOVA results on ($\alpha < 0.05$). The research results were analyzed by the hypothesis that have been determined with FST AMRAP, FST EMOM, and FST FOR TIME training on the biomotor components of strength, agility, and endurance cardiovascular for 8 weeks.

Results

Based on the results of the descriptive analysis, the average total cooling muscle strength before being given the training method with FST AMRAP (K1) was 87.50 kg; FST EMOM (K2) of 77.50; FST FOR TIME (K3) was 75.50 kg. The average agility before being given the training method with FST AMRAP (K1) was 16.33 seconds; FST EMOM (K2) of 16.58 seconds; the ratio of the FST FOR TIME (K3) group was 17.54 seconds. The average cardiovascular endurance before being given the training method with FST AMRAP (K1) was 52.53 ml/kg/minute; FST EMOM (K2) of 52.72 ml/kg/minute; the ratio of the FST TO TIME group (K3) is 52.65 ml/kg/minute. To find out which method has the best improvement, a post-test is carried out on each group which will be shown in Table 3 below;

Table 2. Results Comparison of Pre and Post Test

Kelompok	Variabel	Mean		Perubahan (%)	Keterangan
		Pre-Test	*Post-test*		
FST AMRAP	*Leg Strength*	87,50	105,57	21	
	Agility	16,33	14,05	14	FST AMRAP K1 > K2> K3
	VO²Max	52,53	60,81	12	
FST EMOM	*Leg Strength*	77,50	83,52	8	
	Agility	16,18	12,42	23	FST EMOM K2> K1 > K3
	VO²Max	52,72	56,83	8	
FST FOR TIME	*Leg Strength*	75,50	81,13	7	
	Agility	17,54	15,57	11	FST FOR TIME K2> K3> K1
	VO²Max	52,65	56,37	7	

The results of this analysis provide the conclusion that the functional training method has an impact on improving leg muscle strength, agility, and endurance cardiovascular.

Table 3.
Presentation of Summary Results of Simultaneous Confidence Intervals Analysis (α > 0.05) between Training Groups

Dependent Variable		*Mean*	*95% Confidence Interval*		*Analysis*	
			Lower Bound.	*Upper Bound.*	*"t"*	*p*-value
Leg Strength	FST AMRAP	.650	.280	1.020	.280	α < 0.05
	FST EMOM	1.214	.844	1.585	.844	
	FST FOR TIME	1.493	1.123	1.863	1.123	
Agility	FST AMRAP	-6.500	-10,471	-2.529	-10,471	α < 0.05
	FST EMOM	-4.214	-8.186	-.243	-8.186	
	FST FOR TIME	-2.071	-6.043	1.900	-6.043	
Endurance Cardiovascular	FST AMRAP	-500	-481	-2.529	-481	α < 0.05
	FST EMOM	-1.214	-6.186	-.243	-6.186	
	FST FOR TIME	-1.071	-4.043	1.900	-4.043	

In connection with the results of the analysis above using the simultaneous confidence interval analysis model with a confidence level of 95% in Table 4.10, the following results can be stated.

a. There was an improvement in the leg muscle strength variable, due to the FST AMRAP (K1) training treatment with the lowest increase being 21% with a coefficient of 0.650. Training using the FST EMOM (K2) method with an increase of 8% with a coefficient of 1.214 and training using the FST FOR TIME (K3) with the lowest increase of 7% with a coefficient of 1.493.
b. There was an increase in agility variables, due to FST AMRAP (K1) training treatment with the lowest increase being 14% with a coefficient of 6,500. Training using the FST EMOM (K2) method with an increase of 23% with a coefficient of 4,214 and training using the FST FOR TIME (K3) with the lowest increase of 11% with a coefficient of 2,071.
c. There was an increase in endurance cardiovascular variables, due to the FST AMRAP (K1) training treatment with the lowest increase being 12% with a coefficient of 500. Training using the FST EMOM (K2) method with an increase of 8% with a coefficient of 1,214 and training using FST FOR TIME (K3) with the lowest increase of 7% with a coefficient of 1.071.
d. There were no significant differences between the three groups AMRAP, EMOM, and FOR TIME, $p > 0.05$

The following is a table of increases in FST AMRAP, EMOM, AND FOR TIME for 8 weeks;

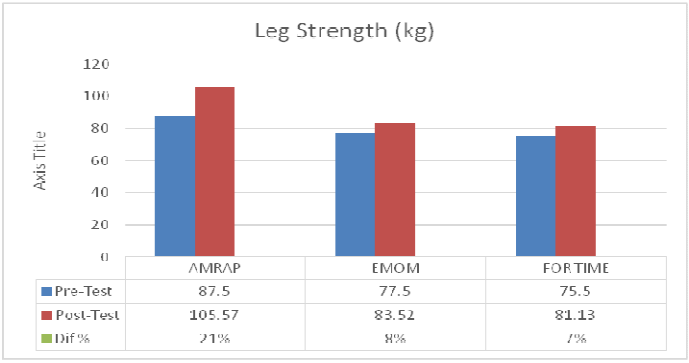

Fig 1. Leg Strength (Pre and Post-Test)

The results of three groups after being given treatment for eight weeks, showed pre and post-agility using shuttle run test in the graph below:

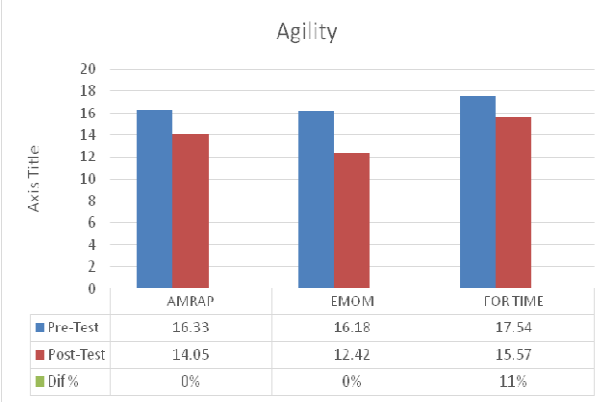

Fig 2. Agility (Pre and Post- Test)

The results of three groups after being given treatment for eight weeks, showed pre and post-endurance cardiovascular using MFT (ml/kg/minute) test in the graph below:

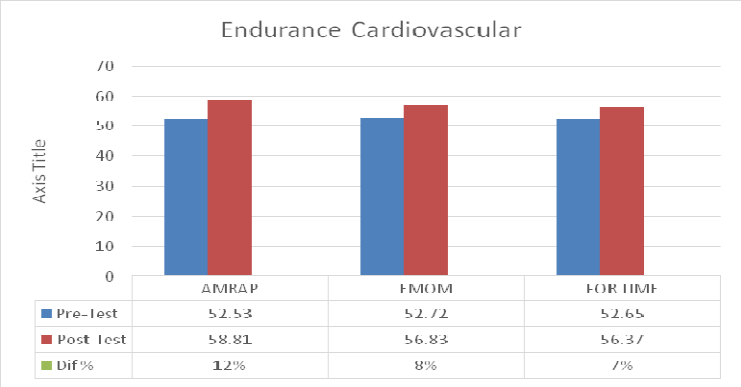

Fig 2. Endurance Cardiovascular (Pre and Post-Test)

Furthermore, the following are the results of the post hoc analysis that was carried out on every group with the variables used below;

Table 4. Post-Hoc Test Summary

No	Variable	Difference	*p*
1.	Leg Strength	*FST AMRAP >< FST EMOM*	0,420
		FST AMRAP >< FST FOR TIME	0,547
		FST EMOM >< FST FOR TIME	0,621
2.	Agility	*FST AMRAP >< FST EMOM*	0,626
		FST AMRAP >< FST FOR TIME	0,721
		FST EMOM >< FST FOR TIME	0,843
3.	Endurance Cardiovascular	*FST AMRAP >< FST EMOM*	0,765
		FST AMRAP >< FST FOR TIME	0,654
		FST EMOM >< FST FOR TIME	0,876

The results have shown that FST As many rounds as possible (Amrap), FST Every Minute on the Minute (Emom), and FST FOR TIME didn't have a significant difference effects in increasing leg strength (leg dynamometer) because the p-value level was > 0.05, the biomotor component of agility (20m shuttle run) didn't have a significant difference effect in the three group and there was no significant different between three group (AMRAP. EMOM, and FOR TIME) in improving endurance cardiovascular.

Discussion

The effect of short-term functional strength training (FST) over eight weeks has been proven to significantly influence an increase in leg strength, agility, and endurance cardiovascular in male basketball student-athletes. If viewed from a physiological aspect, muscle strength cools down for 8 weeks where the frequency of changes three times a week with a rest break of one day a week can be used by the muscles to develop so that energy metabolism in athletes also increases, seen from training intensity and volume. training in which a basketball athlete does not get muscle fatigue when competing (Cao, 2011), so it is a supporting factor in minimizing the occurrence of injuries during competition and overuse during training (Selenica, 2022). An athlete who has excellent physical condition, especially in game sports, will easily adapt to the tempo and rhythm of the game. When entering the season stage, supported by good fitness strength (Seitz, 2014), an athlete can make movements quickly and change direction perfectly with the pulse following. which is not easily high, which means that the athlete's cardiovascular endurance is in good condition so that the match will be played well. However, this research does not provide additional treatment related to techniques in the sport of basketball such as dribbling, throwing, putting the ball into the ring, and so on (Oxfeldt, 2019), so this is one additional thing that can later be carried out in development research.

Referring to the research results, the novelty in previous research was only the development of functional training to increase the biomotor components of agility and balance and had a positive impact for 12 weeks (Wibowo, 2019) where the development of a FST program with AMRAP, EMOM and FOR TIME models used 8 posts/station consisting of the deadlift, back squat, barbell clean and press, icky shuffle, skipping rope, devil press, slam ball throw, and sled push with intensity 85-90%, volume 40% 1 RM and for eight weeks the training volume increases by 20% every 2 weeks (Anthony, 2021), so the results of this research are very effective and efficient in improving the physical condition of basketball student-athletes aged 15-17 years for eight weeks. This, of course, has an impact on daily nutrition beyond the control of the training program, resulting in the impact of incorrect macro and micronutrients in athletes' eating behavior, such as consuming foods that contain free radicals such as; Preservatives, artificial sweeteners, oils and flavorings that are consumed for a long time

will have an impact on reducing performance and performance (Scanlan, 2018). Training in physical fitness is generally separated into two seasons (during the off-season and in-season), where a trainer can use the FST within these 8 weeks to improve biomotor skills, especially strength, agility, and endurance. optimal cardiovascular performance during competition and minimize the occurrence of injury or overuse.

Conclusions

Based on the research results, there was a significant effect during the 8 weeks of carrying out the AMRAP functional training program on leg strength, agility, and endurance cardiovascular. The results in FST AMRAP experienced an improvement with the highest percentage with every variables, namely 21% in leg strength, this is proven by the average pre-test result of 87.50 kg and post-test of 105.57 kg. Meanwhile, in the biomotor component of agility, there was an increase of 14% by the pre-test result (average) of 16.33 seconds and an average post-test value of 14.05 seconds, then in increasing endurance cardiovascular, there was an increase of 12% from the average pre-test result. test 52.53 ml/kg/minute and post-test (average) 60.81 ml/kg/minute. The effect of every minute on the minute (EMOM) on leg strength, agility, and endurance cardiovascular for eight weeks, there was a significant influence on leg strength by 8% of the pre-test average of 77.50 kg and the post-test average of 83.52 kg and on the components biomotor agility increased by 23% with a pre-test (average) result of 16.18 seconds and an average post-test value of 12.42 seconds, then in increasing endurance cardiovascular, there was an increase of 8% from the pre-test (average) result of 52. 72 ml/kg/minute and post-test average 56.83 ml/kg/minute. Effect of FORTIME on the leg strength, agility, and endurance cardiovascular. It was significant increase in FORTIME by the leg strength 7%, agility by 11%, and endurance cardiovascular by 7%, average pre-test result for leg strength was 75.50 kg and the average post-test was 81.13 kg, then the agility test with the average pre-test result was 17.54 seconds and the average post-test was 15.57 seconds. seconds and the average pre-test result of endurance cardiovascular was 52.65 ml/kg/minute, increasing significantly over eight weeks to 56.37 ml/kg/minute from the average post-test result.

This research hypothesizes that there is a difference in influence significance among the three dependent variables, but the results of this study showed no differences between the three groups of functional strenght training (FST) program's as many rounds as possible (AMRAP), every minute on the minute (EMOM), and FOR TIME exercises. So it can be concluded that the FST AMRAP model is effectively used to increase leg muscle strength and endurance cardiovascular, because treatment requires shorter rest periods, as in the findings of (Mckanzie, 2019) that very short rest intervals will have an impact on the quality of endurance (neuromuscular and cardiovascular) in terms of training intensity, training movements, number of stations, and exercise volume. The FST EMOM model significantly increases the biomotor component of agility because this training method and model requires very fast rest intervals for each individual, most recently the FST FOR TIME experienced the greatest increase in the agility component, but it is more efficient and effective using the FST AMRAP training model and FST EMOM in terms of the average pre-test results for agility using FST FOR TIME was 17.54 seconds and the average post-test value was 15.57 seconds, while in increasing leg strength the FST AMRAP and FST EMOM were more efficient in terms of the average results. The average pre-test FST FOR TIME was 75.50 kg and the average post-test value was 81.13, increasing by 7%. This research concludes that there was a significant increase in FST AMRAP, EMOM, and FOR TIME training with a sig level $t < 0.05$ and there was no significant difference in the effect of the third group with on leg strength, agility and endurance cardiovascular for 8 weeks signed. level ($p > 0.05$).

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