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Research Article

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Investigating the Effects of Am rap and Classic Cross-fit Training in Freestyle Wrestlers on Physical Fitness Parameters

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Abstract: This study aims to investigate anaerobic strength alterations of wrestlers who perform AMRAP (As many reps as possible) and Classic CrossFit pieces of training. The research was implemented on 32 male wrestlers who were challenged in the Turkish Wrestling 1st League in the season of 2018-2019. The volunteer participants taken part in test groups performed CrossFit models in the preseason for 8-weeks; Group I (Classic CrossFit) and Group II (CrossFit AMRAP). Bodyweight, height, and age values were recorded respectively by creating measuring parkour and arranged on MS Excel spreadsheet program. Two-factor variance analysis was used in repetitive measurements for identifying the differences between pre and final measuring anaerobic strength values of the participants. As findings, it was observed there was a significant difference in terms of group x time interaction dimension in back squat movement, 1 min on behalf of AMRAP. According to the simple effect test results, there were significant values in both groups. The numerical increase in some performance values of the AMRAP CrossFit training group after 8-weeks of training was more prominent than the classic CrossFit training group. In addition, AMRAP CrossFit training was effective in reducing body weight. Both models were found to have a positive effect on their physical capacities effectively. Although there are studies on CrossFit in the literature, there is no significant study on AMRAP and thus this study might be the pioneer in terms of contributions to the literature and lead to further comments on sports science as well. Thus, this study is significant to reveal the effectiveness of Amrap and CrossFit training on physical fitness parameters.

Keywords: CrossFit, strength, training, wrestling.

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1. INTRODUCTION

CrossFit, which has grown worldwide and become an important brand, is a training model with a high-intensity interval structure.1 CrossFit training method is generally performed in a structure that includes multi-joint functional movements and far from isolated exercises.2 CrossFit aims to develop 10 basic motor skills. These are power, speed, strength, coordination, cardiovascular endurance, endurance, flexibility, agility, balance, and accuracy, and these were all obtained by Glassman.3In order to develop these targeted bio motor movements; functional movements, Olympic lifts, gymnastics and combined exercises involving strength and plyometric exercises were applied.4 CrossFit exercises are usually performed in a content defined as an exercise recipe called "Workout of the Day (WOD)". The Workout of the Day modality consists of 3 phases; metabolic conditionings including gymnastics, cardiovascular exercises, and Olympic lifts with lifts and hurdles to give flexibility and body awareness in the movements performed.[5]Various methods are used as a working method in Workout of the Day. Sometimes classical repetition and set numbers, AMRAP new methods are used. The AMRAP method consists of the initials of the word "As Many Rounds as Possible" and can be translated into Turkish as many repetitions (time) as possible [6]. In this protocol, athletes try to make sets and repetitions as much as possible without resting during the specified period.[1] When we look at CrossFit studies, we see that these movements are performed in a short time, in high intensity and high volume.[7- 9]When looking at the movement profile of the wrestling branch, sudden and blasting attacks and counter-attacks are often made.[10] Throughout the competition, short and blasting moves are provided through the anaerobic system. Quick moves are produced by dominant maximal power and high fatigue and lactate profile are observed[11]. It was thought that specific condition studies may be appropriate for wrestling with CrossFit training modeling. Although functional training is not the same as CrossFit™, it does provide evidence on the potential effectiveness of this training programs[12].In limited studies in the literature, it was observed that CrossFit studies provide improvement in general physical fitness data and benefit from certain aspects compared to some high-intensity training modalities [13-15]. It was observed that a regular 8-week training had a highly significant effect on the body mass index due to the multi-jointed and high-intensity structure of CrossFit studies[15]. In a study comparing CrossFit and circular training, it was seen that CrossFit training improved lower extremity and muscle endurance similarly.[16] In the study comparing CrossFit and traditional strength training, no statistical difference was found in pull-up and active jump, but the effect size of conventional work was higher in lower extremity strength. However, CrossFit showed significant differences in cardio inspirator parameters, and VO2 Max was found to be a more effective enhancer. This suggests that CrossFit can be used as a suitable method in studies involving athletic performance such as wrestling.[13]It is known that CrossFit exercises improve aerobic power. Also, it was made clear that in a detailed 6-week study, very significant changes were found out in Deadlift, Squat, Shoulder Press, 500-meter rowing parameters, as well as cardiovascular parameters of trained individuals. In addition, they found that the stage at which athletes approached exhaustion was later.[17]Hand grip strength in wrestling is a very important parameter both in competition and training.[18,19] It is known that one of the significant changes created by CrossFit applications on sedentary individuals is handgrip strength.[20] In addition, as an indicator of anaerobic power output, statistically significant increases were observed in vertical jump parameters after 8 weeks in Cindy training modeling.[21] After the literature was reviewed thoroughly, it was observed that this issue should be examined closely and revealed well to have a better understanding. Even though there are studies related to Classic CrossFit training, there is still a lack of studies to grasp the importance of AMRAP and its effects in this respect. Thus, this study aims to examine the effect of classical CrossFit applications and the AMRAP model on wrestlers according to some physical fitness parameters. In the light of the findings and results, this study will be a pioneer within this profile and shed the light for further research in sports science by encouraging and facilitating the literature as well.

2. MATERIAL AND METHODS

2.1 *Participants*

32 healthy male wrestlers, who were competing actively in Turkey Wrestling 1st League of 2018-2019 and active for the last 5 years, participated as volunteers in our study. Age average values of the wrestlers (n = 16) in the Test-I (Classic CrossFit Training) group were 20.8 ± 1.15 years, their height values were 175.2 ± 5.03 cm, their body weight values were 80.7 ± 8.4 kg. In Test-II (CrossFit AMRAP; As many reps or rounds as possible), the age averages of the wrestlers (n = 16) were 20.93 ± 1.06 years, their height was 176.5 ± 1.4 cm and their body weight was 80.8 ± 8.7 kg.

2.2 Inclusion Criteria

- Participated in Wrestling 1st League in Turkey
- Age 18 and older
- Physically and mentally healthy

2.3 Exclusion Criteria

- Having health problems
- Having disabilities

2.2 *Research Design*

This study was conducted on 32 healthy male wrestlers following the ethical standards and a written consent form was taken from the individuals for scientific purposes. Written and verbal explanations about the research to be made and the measurements to be taken were made to the individuals involved in the study. Those who accepted to take part in this study were asked to fill in the "Voluntary Consent Form". This study was approved by the Human Research Ethics Committee of Middle East Technical University and approved with protocol number 312-ODTÜ-2019. Volunteer participants in the test groups who were 18 years and older, had no physical or health problems and were taking part in sports activities during the pre-season preparation period for 8 weeks; Group I (Classic CrossFit) and Group II (CrossFit AMRAP; As many reps or rounds as possible) groups applied CrossFit models 3 days a week (Monday, Wednesday, Friday). During the remaining days (Tuesday, Thursday, Saturday) they participated in routine wrestling training. Before the test, each participant was given a 15-minute progressive standard warm-up in the field. All tests were done on the same day and were inspected and recorded by

the same researchers. The age, height, and bodyweight of the volunteer participants were determined. From the volunteer participants in the test and control groups;

2.3 *Data Collection Process*

2.3.1 Height and Body Weight

Participants were provided to take a position to touch the caliper heads sliding on the scale while standing upright with the Holtain brand sliding caliper and the length was read with a precision of 1 mm. Weight measurements were made on a weighing scale with an accuracy of 0.01 kg (Angel Brand). While the participant was upright on the scale and his body weight was equally distributed on both feet, the measurement was recorded on the forehead and in kg.[22]

2.3.2 Subcutaneous Fat Measurement:

Measurement was taken from M. triceps brachii, M. biceps brachii, M. subscapularis, M. pectoralis, M. quadriceps femoris muscles, and abdomen regions with supra iliac from the participants suitably to measuring protocol with Holtain brand skinfold caliper [23, 24]. Lange's formula ((Biceps ± Triceps ± Subscapula ± Pectoral ± Suprailiac ± Quadriceps) x 0.097 ± 3.64) was used to identify body fat percentage.[25]

2.3.3 One (1) Maximum Repetition (1 RM):

After participating in the proper sitting/holding position to the fitness equipment Senkron (TURKEY), a preliminary trial application was provided without any resistance. After determining the maximum weight to be lifted as an estimate, by making a trial, the highest-level weight was recorded as kg. A Maximum Repetition (1RM) test was determined in the form of the back squat, shoulder press, barbell biceps curl, bench press free weight, while triceps push down, lat pull down, and machine rowing was determined at the fitness machine station.[26]

2.3.4 Back Force Test:

Participants' back force was determined by Takei (Japan) brand back and leg dynamometer. After the athletes placed their feet on the dynamometer stand with their knees stretched, they were asked to pull the dynamometer bar, which they grasp with their hands, to the maximum extent vertically, with the arms stretched, the back straight and the body slightly bent forward. This test was applied three times and the best value was included in the study.[27]

2.3.5 Hand Grip Strength Test:

Participants' handgrip strength was determined by Takei Grip-D (Japan) brand hand dynamometer. The dynamometer was adjusted according to the participant's hand size. The measurements were carried out with the research group standing, arms lowered, squeezing the dynamometer with maximum force without touching the body. Three measurements were made for the right and left hands separately and the best value was found in kg.[28]

2.3.6 Vertical Leap Test:

The vertical jump height of the participants was determined using the Takei jump meter (Japan). The participants were told about the application of the test. Three attempts were made at 60-second intervals and the best value was recorded as the jump height.[22]

2.3.7 Push-Up Test (1 minute):

A 60-second push-up test was conducted to evaluate the upper body strength and continuity of the participants. The participants were asked to stand in the prone position, with hands shoulder-width apart and full lower body weight on the toes. The participants were instructed to start in a position with arms extended forward while keeping their head, shoulders, back, hips, knees, and feet in a straight line. The participants bent their upper arms parallel to the ground and returned to the starting position.[29] The push-up custom of the participants within 60 seconds was recorded. Participants were encouraged to make the maximum effort during the test.

2.3.8 Sit-up Test (1 minute):

Participants were made to sit up with bent knees within 1 minute. Participants were asked to lie on their back with their knees bent and feet flat on the floor. Hands were placed on the back of the head. Participants were asked to raise the trunk until their elbows touch the legs, and to practice the movement for 60 seconds consecutively and recorded. Participants were encouraged to make the maximum effort during testing.[30]

2.4 *Training Protocol*

Test groups, Test I (CrossFit AMRAP; As many reps as possible) and Test II (Classic CrossFit) implemented CrossFit models three days a week (Monday, Wednesday, Friday) for eight weeks. In addition to the CrossFit models, the participants in both training groups performed the wrestling training, which included wrestling combined technique and tactical pieces of training, three days a week (Tuesday-Thursday-Saturday), on the condition that the scope and intensity of the training were parallel to the 8 weeks.

Table 1. ***Classic and AMRAP CrossFit Training Program***

		Days					
WEEKS		**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
1st and 2nd	Morning	A-Classic CrossFit Training	The test was not performed	A-Classic CrossFit Training	The test was not performed	A-Classic CrossFit Training	The test was not performed
	Evening	A[1]-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	A[1]-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	A[1]-AMRAP CrossFit Training	Wrestling Technical and Tactical Training
3rd and 4th	Morning	B-Classic CrossFit Training	The test was not performed	B-Classic CrossFit Training	The test was not performed	B-Classic CrossFit Training	The test was not performed

	Evening	B^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	B^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	B^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training
5th and 6th	Morning	C-Classic CrossFit Training	The test was not performed	C-Classic CrossFit Training	The test was not performed	C-Classic CrossFit Training	The test was not performed
	Evening	C^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	C^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	C^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training
7th	Morning	D-Classic CrossFit Training	The test was not performed	D-Classic CrossFit Training	The test was not performed	D-Classic CrossFit Training	The test was not performed
	Evening	D^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	D^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	D^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training
8th	Morning	E-Classic CrossFit Training	The test was not performed	E-Classic CrossFit Training	The test was not performed	E-Classic CrossFit Training	The test was not performed
	Evening	E^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	E^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training	E^{I}-AMRAP CrossFit Training	Wrestling Technical and Tactical Training

A-Classic CrossFit Training (1st and 2nd Week): The training program including 10 stations created by the participants was performed circularly. After the defined station was implemented for 30 seconds, they switched to the other station. The participants made the performance in all stations. Five sets were implemented in total. 1- or 2-minutes rest between sets was given. 1st Tire & sledgehammer (10 kg), 2ndCrunch, 3rd Burpee, 4th Hyperextension, 5th TRX-rowing, 6th Ab Roller crunch, 7th Rope swinging (12 kg each rope), 8th Tire flips (28 kg), 9th Skipping rope, 10th Dynamic plank stations were implemented. The participants performed the movements according to the order of the movements in stations (Table 1).*A^{I}-AMRAP (As many reps or rounds as possible) CrossFit Training (1st and 2nd Week):* Participants were provided with the highest number of repetitions they could do in the stations specified in the Classic CrossFit Training (1. and 2. Week) protocol. The number of repetitions that individual participants could do was recorded. During the eight-week training period, each week, participants were asked to increase the number of repetitions in stations within the specified time (Table 1). *B-Classic CrossFit Training (3rd and 4th Week):* The training program including 9 stations created by the participants was performed circularly. After the defined station was implemented for 45 seconds, they switched to the other station. The participants made the performance in all stations. Six sets were implemented in total. 1- or 2-minutes rest between sets was given. 1st Tire & sledgehammer (10 kg), 2nd Crunch, 3rd Burpees box jump over, 4th Hyperextension, 5th Ring dips, 6th Ab Roller crunch, 7th Rope swinging (12 kg each rope), 8th Air squat, 9th Dynamic plank stations were implemented. The participants performed the movements according to the order of the movements in stations (Table 1).*B^{I}-AMRAP (As many reps or rounds as possible) CrossFit Training (3rd and 4th Week):* Participants were provided with the highest number of repetitions they could do within the specified time at the stations included in the Classic CrossFit Training (3rd and 4th week) protocol. The number of repetitions that individual participants could do was recorded. During the eight-week training period, each week, participants were asked to increase the number of repetitions within the specified time (Table 1). *C-Classic CrossFit Training (5th and 6th Week):* The training program including 10 stations created by the participants was performed circularly. After the defined station was implemented for 45 seconds, they switched to the other station. The participants made the performance in all stations. Six sets were implemented in total. 1- or 2-minutes rest between sets was given. 1st Tire & sledgehammer (10 kg), 2nd Hyperextension, 3rd Walking lunge (20 kg dumbbell each hand), 4th Crunch, 5th Push Press (Olympic Bar ± plate; 25 kg), 6th Box jumps (40 cm), 7th TRX-push up, 8th Ab Roller crunch, 9th Rope swinging (12 kg each rope), 10th Tire flips (28 kg) stations were implemented. The participants performed the movements according to the order of the movements in stations (Table 1). *C^{I}-AMRAP (As many reps or rounds as possible) CrossFit Training (5th and 6th Week):* Participants were provided with the highest number of repetitions they could do within the specified time in the stations included in the Classic CrossFit Training (5th and 6. Week) protocol. The number of repetitions that the individual participants can do was recorded. During the eight-week training period, they were asked to increase the number of repetitions within the specified time in the stations every week (Table 1). *D-Classic CrossFit Training (7th Week):* The training program including 5 stations created by the participants was performed circularly. After the defined station was implemented for 45 seconds, they switched to the other station. The participants made the performance in all stations. Six sets were implemented in total. 3- or 5-minutes rest between sets was given. 1st Back squad (% 60 of 1 Maximum repetition), 2nd Butterfly pull up, 3rd Dumbbell Turkish sit up (% 60 of 1 Maximum repetition), 4th Crunch, 5th Push-up stations were implemented. The participants performed the movements according to the order of the movements in stations (Table 1). *D^{I}-AMRAP (As many reps or rounds as possible) CrossFit Training (7th Week):* Participants were provided with the highest number of repetitions they could do within the specified time at the stations included in the Classic CrossFit Training (7. Week) protocol. The number of repetitions that individual participants could do was recorded. During the eight-week training period, each week, participants were asked to increase the number of repetitions within the specified time (Table 1). *E-Classic CrossFit Training (8th Week):* The training program including 3 stations created by the participants was

performed circularly. After the defined station was implemented for 45 seconds, they switched to the other station. The participants made the performance in all stations. The participants continued the combined station consisting of 3 stations until they could not make their movement forms one after the other, without a break. 2 sets were applied. 5 minutes rest was given between sets. 1st Push press (% 60 of 1 Maximum repetition), 2nd Deadlift (% 60 of 1 Maximum repetition), 3rd Butterfly pull up (% 60 of 1 Maximum repetition), 4th Crunch, 5. Push-up stations were implemented. The participants performed the movements according to the order of the movements in stations (Table 1). *E[1]-AMRAP (As many reps or rounds as possible) CrossFit Training (8th Week):* Participants were provided with the highest number of repetitions they could do in the stations specified in the Classic CrossFit Training (8th Week) protocol. The number of repetitions that the individual participants could do was recorded. During the eight-week training period, they were asked to increase the number of repetitions within the specified time in the stations every week (Table 1). *Wrestling Technical and Tactical Training (1. and 8. Week):* The participants in Group I (CrossFit AMRAP; As many reps or rounds as possible) and Group II (Classical CrossFit) groups have performed wrestling combined technical and tactical training 3 days a week (Tuesday-Thursday-Saturday) for 8 weeks provided that the scope and severity are parallel. HIIT (Highly Intensive Interval Training) program was implemented under the characteristics of the wrestling branch. 10 minutes warm-up (jogging and running, then static and dynamic stretching of the lower and upper extremities), 20 minutes routine wrestling exercises, 22-55 minutes HIIT (eight wrestling techniques), and 10 min in each training session. Cooling (standard stretching). Wrestling exercises were carried out as a unit training for 90 minutes (Table 1).[31]

3. STATISTICAL ANALYSIS

In the analysis of the data, MS Excel (2012) for Windows was used and graphics were added. It was written in MS Word (2007) for Windows. Statistical analysis was written in the SPSS (17.0) program for Windows. In the study, two-way ANOVA for repeated measures was used in determining the difference between the first and last measurement anaerobic power values of the test and control group participants. To determine the appropriate test, the normal distribution of the data was checked before testing the hypotheses. The significance level was evaluated as $p < 0.05$.

4. RESULTS

Table 2. ***Bodyweight values group x time interaction***

Group	Measurement	N	Average. ± Std. Error			F	P
AMRAP	Pretest	16	80.863	±	8.736	0.583	0.541
	Final test	16	79.731	±	8.608		
Classical	Pretest	16	80.750	±	8.453		
	Final test	16	80.160	±	7.573		

Abbreviations: F, the variance of the group means (Mean Square Between) / mean of the within-group variances (Mean Squared Error); df, degrees of freedom (df=1.30; p<0.05), P; Statistical Significance

When the obtained results were evaluated, no statistical difference was found between the pre-test and post-test mean values of the AMRAP group and the pre-test and post-test values of the classical group in terms of group time interaction ($p < 0.05$) (Table 2).

Table 3. ***Bodyweight values, simple affect test results***

Group	Measurement (2)	Measurement (1)	Mean Diff. ± Std. Error		P
AMRAP	Final test	Pretest	-1.131	0.501	0.031*
Classical	Final test	Pretest	-0.59	0.501	0.248

Abbreviations P; Statistical Significance, Measurement (1): The measurement before the test Measurement (2): The measurement after the test was performed

According to the simple affect test results, the change between the pre and post body weight values of the AMRAP group was found statistically significant according to the analysis results, while the change in the classical group has not been found statistically significant (Table 3).

Table 4. ***Body fat percentage values group x time interaction***

Group	Measurement	N	Average ± Std. Error			F	P
AMRAP	Pretest	16	11.687	±	2.556	3.333	0.078
	Final test	16	10.292	±	2.366		
Classical	Pretest	16	12.383	±	1.493		
	Final test	16	11.724	±	7.573		

Abbreviations: F, the variance of the group means (Mean Square Between) / mean of the within-group variances (Mean Squared Error); df, degrees of freedom (df=1.30; p<0.05) P; Statistical Significance

When the obtained results were evaluated, when the difference between the pre-test and the post-test mean value of the AMRAP group in the dimension of group time interaction was compared with the difference between the pre-test and the post-test values of the classical group, no statistical difference was found ($p < 0.05$) (Table 4).

Table 5. ***Body fat percentage values, simple affect test results***

Group	Measurement (2)	Measurement (1)	Mean Diff. ± Std. Error		P
AMRAP	Final test	Pretest	-1.395	0.285	0.000*
Classical	Final test	Pretest	-.660	0.285	0.028*

Abbreviations; P; Statistical Significance, Measurement (1): The measurement before the test Measurement (2): The measurement after the test was performed

According to the simple effect test results, the change between the pre and post-body weight values of the AMRAP and classical training group was found statistically significant according to the analysis results (Table 5).

Table 6. 1 ***Maximal Repetition values group x time interaction***

Measurement	Group	Measurement	N	Average ± Std. Error		F	P
Back Squat	AMRAP	Pretest	16	120.400	10.083	15.154	0.001*
		Final test	16	143.500	8.000		
	Classical	Pretest	16	125.194	7.565		
		Final test	16	137.694	8.402		
Bench Press	AMRAP	Pretest	16	92.400	11.273	4.040	0.054
		Final test	16	99.763	11.213		
	Classical	Pretest	16	86.256	5.498		
		Final test	16	95.506	5.808		
Shoulder Press	AMRAP	Pretest	16	57.375	5.268	2.778	0.106
		Final test	16	60.638	4.976		
	Classical	Pretest	16	55.981	5.154		
		Final test	16	60.288	4.571		
Machine Rowing	AMRAP	Pretest	16	97.806	15.493	2.901	0.099
		Final test	16	121.675	17.511		
	Classical	Pretest	16	91.656	10.177		
		Final test	16	110.763	9.570		
Biceps Barbell Curl	AMRAP	Pretest	16	49.500	8.327	1.009	0.323
		Final test	16	58.000	8.010		
	Classical	Pretest	16	45.200	4.258		
		Final test	16	52.381	3.261		
Triceps Push Down	AMRAP	Pretest	16	75.506	11.151	3.842	0.059
		Final test	16	94.769	14.453		
	Classical	Pretest	16	72.463	12.097		
		Final test	16	97.231	11.432		
Lat Pull Down	AMRAP	Pretest	16	90.963	12.761	0.050	0.825
		Final test	16	108.056	15.979		
	Classical	Pretest	16	85.388	6.149		
		Final test	16	101.931	8.898		

Abbreviations: F, the variance of the group means (Mean Square Between) / mean of the within-group variances (Mean Squared Error); df, degrees of freedom (df=1.30; p<0.05) P; Statistical Significance

When the obtained results were evaluated, the difference between the pre-test and post-test mean values of the AMRAP group and the pre-test and post-test values of the classical group were found statistically significant in only squat value in the group time interaction (p <0.05) (Table 6).

Table 7. ***1 Maximal Repeat values, simple affect test results***

Test	Group	Measurement (2)	Measurement (1)	Mean Diff. ± Std. H.		P
Back Squat	AMRAP	Final test	Pretest	23.100	1.925	0.000
	Classical	Final test	Pretest	12.500	1.925	0.000
Bench Press	AMRAP	Final test	Pretest	7.362	0.664	0.000
	Classical	Final test	Pretest	9.250	0.664	0.000
Shoulder Press	AMRAP	Final test	Pretest	3.262	0.443	0.000
	Classical	Final test	Pretest	4.306	0.443	0.000
Machine Rowing	AMRAP	Final test	Pretest	23.869	1.977	0.000
	Classical	Final test	Pretest	19.106	1.977	0.000
Biceps Barbell Curl	AMRAP	Final test	Pretest	8.500	0.928	0.000
	Classical	Final test	Pretest	7.181	0.928	0.000
Triceps	AMRAP	Final test	Pretest	19.262	1.986	0.000

Push Down	Classical	Final test	Pretest	24.769	1.986	0.000
Lat Pull Down	AMRAP	Final test	Pretest	17.094	1.748	0.000
	Classical	Final test	Pretest	16.544	1.748	0.000

Abbreviations; P; Statistical Significance, Measurement (1): The measurement before the test Measurement (2): The measurement after the test was performed

According to the simple effect test results, the change that occurred between AMRAP and all pre and post 1 maximal repeat tests of the classical training group was found statistically significant according to the results of the analysis (Table 7).

Table 8. ***Claw strength and Back force values group x time interaction***

Measurement	Group	Measurement	N	Average ± Std. H.		F	P
Right Claw	AMRAP	Pretest	16	50.269	2.813	0.968	0.333
		Final test	16	53.231	3.983		
	Classical	Pretest	16	52.150	4.852		
		Final test	16	54.188	5.079		
Left Claw	AMRAP	Pretest	16	49.619	3.981	2.202	0.148
		Final test	16	52.400	3.352		
	Classical	Pretest	16	52.219	5.167		
		Final test	16	54.288	5.420		
Back Force	AMRAP	Pretest	16	143.731	5.519	0.071	0.791
		Final test	16	151.188	3.635		
	Classical	Pretest	16	142.881	11.667		
		Final test	16	149.863	11.973		

Abbreviations: F, the variance of the group means (Mean Square Between) / mean of the within-group variances (Mean Squared Error); df, degrees of freedom (df=1.30; p<0.05) P; Statistical Significance

When the obtained results were evaluated, in the group time interaction dimension, the difference between the pre-test and post-test mean values of the AMRAP group and the difference between pre-test and post-test values of the classical group were not found statistically significant in all strength tests (Table 8).

Table 9. ***Claw Force and Back Force power values***

Test	Group	Measurement (2)	Measurement (1)	Average ± Std. H.		P
Right Claw	AMRAP	Final test	Pretest	2.963	0.665	0.000
	Classical	Final test	Pretest	2.038	0.665	0.005
Left Claw	AMRAP	Final test	Pretest	2.781	0.340	0.000
	Classical	Final test	Pretest	2.069	0.340	0.000
Back Power	AMRAP	Final test	Pretest	7.456	1.257	0.000
	Classical	Final test	Pretest	6.981	1.257	0.000

Abbreviations; P; Statistical Significance, Measurement (1): The measurement before the test Measurement (2): The measurement after the test was performed

According to the simple effect test results, the change that occurred between AMRAP and all pre and post-strength tests of the classical training group were found statistically significant according to the results of the analysis (Table 9).

Table 10. ***Push-up, Sit up, and Vertical jump tests***

Measurement	Group	Measurement	N	Average ± Std. H.		F	P
1 min Push up	AMRAP	Pretest	16	56.125	6.712	4.971	0.033*
		Final test	16	64.750	8.161		
	Classical	Pretest	16	53.000	4.546		
		Final test	16	58.938	6.807		
1 min Sit up	AMRAP	Pretest	16	51.875	5.608	1.455	0.237
		Final test	16	58.375	7.822		
	Classical	Pretest	16	51.625	7.108		
		Final test	16	56.250	8.136		
Vertical jump	AMRAP	Pretest	16	46.313	4.191	8.523	0.007*
		Final test	16	50.125	4.631		
	Classical	Pretest	16	46.938	3.568		
		Final test	16	49.063	3.356		

Abbreviations: F, a variance of the group means (Mean Square Between) / mean of the within-group variances (Mean Squared Error); df, degrees of freedom (df=1.30; p<0.05) P; Statistical Significance

When the obtained results were evaluated, the difference between the pre-test and post-test mean values of the AMRAP and the difference between the pre-test and post-test values of the classical group were statistically significant in the values of 1-minute push-up and vertical jump tests in the group time interaction dimension (p> 0.05) (Table 10).

Table 11. ***Push up, Sit up, and Vertical jump simple effect tests***

Test	Group	Measurement (2)	Measurement (1)	Mean Diff. ± Std. H.		P
1 min Push up	AMRAP	Final test	Pretest	8.625	0.852	0.000
	Classical	Final test	Pretest	5.938	0.852	0.000
1 min Sit up	AMRAP	Final test	Pretest	6.500	1.099	0.000
	Classical	Final test	Pretest	4.625	1.099	0.000
Vertical jump	AMRAP	Final test	Pretest	3.813	0.409	0.000
	Classical	Final test	Pretest	2.125	0.409	0.000

Abbreviations; P; Statistical Significance, Measurement (1): The measurement before the test Measurement (2): The measurement after the test was performed

According to the results of the simple effect test, the change that occurred between the 1-minute push-up, 1-minute sit up and vertical jump tests of the AMRAP and classical training group was found statistically significant according to the results of the analysis (Table 11).

5. DISCUSSION

Once the literature was reviewed, the need of investigating CrossFit and AMRAP models was considered crucial because there was a lack of sources related to this area. For this reason, the aim is to determine the effect of classical CrossFit training and CrossFit AMRAP training on some physical fitness parameters. When we look at the effect of 8-week training models on physical parameters, according to the group x time interaction; at the end of the training period, it was observed that there was a significant change in back squat movement, 1-minute push-ups, and vertical jump values in 1 maximal repeat tests in two CrossFit models. At the same time, when the first and last measurements of the groups (simple effect) were examined, the decrease in body weight was found to be significant in the CrossFit AMRAP training group, while the decrease in body weight was not found significant in the CrossFit classic training group. In addition, in both groups, it was found significant in numerical improvement in the values of body fat percentage, 1 maximal repetition (1 RM; back squat, bench press, shoulder press, machine rowing, biceps barbell curl, triceps pushdown, lat pull down), right claw force, left claw force, back strength, 1 min. sit up, 1 min. push up and vertical jump. Body mass is important in CrossFit performance. It is essential to pay attention to the balance between maximal strength and body mass.[32] This situation may differ depending on the WOD performed.[33-35] Goins, has investigated the effects of 6 weeks of CrossFit training on some physical and physiological variables. He stated that there was no significant improvement in body fat percentage and body weight values[17], Bellar et al., stated that the difference in body weights (83.8 ± 11.7 kg) of experienced athletes with an average age of 22.3 ± 1.9 and never participating in the competition (83.5 ± 12.2 kg) and experienced athletes with an average age of 26.7 ± 4.3 years was not statistically significant.[33] Bellar et al., stated that the difference in body weights of experienced sportsmen (83.8±11.7 kg) who participated in competitions and their age averages were 26.7±4.3 compared to the body weights of the sportsmen (83.5±12.2 kg) who had never participated in any competition and their age averages were 22.3±1.9 was not statistically significant.[33] Mangine et al., reported the body fat percentage measurements of male sportsmen as advanced CrossFit group (11.0±2.6 %), recreational CrossFit group (16.1±6.2 %), and control group performing traditional training (13.7±3.2 %) in their study.[36] They also stated that there was no difference according to gender but there was a difference in groups in female and male total and the lowest fat percentage was observed in the advanced CrossFit (11.4±2.3 %) group (rec; 19.7±5.8 & con;18.1±7.6 %). Smith et al. identified that there was a significant decrease in body fat percentage after CrossFit based 10-week HIPT program.[37] Heinrich et al implemented a study on cancer patients whose

age ranges were between 35-65. And they stated that there was a significant decrease in body fat percentage at the end of CrossFit training which was similar to 5-week highly intensive functional training.[38] Söyler and Kayantas stated that functional training (CrossFit, HIIT) implemented on football players during the preseason was effective on body composition.[39] It was seen in the literature that CrossFit training protocols had different results. In this study, it was found out that while there was a significant decrease in only the CrossFit-AMRAP group in terms of body weight, there was a significant decrease in both the classic CrossFit group and CrossFit AMRAP group as well. The fact that there are similar and different results in literature can be explained with the content of implemented CrossFit training protocols and the period of conducted performances. With this regard, in this research, the difference between the CrossFit AMRAP model and the Classic CrossFit model can be explained with the increase in the number of repeated actions within a fixed time at the stations and the effect of loading more compared to the classic CrossFit model. Strength, endurance, and experience are important determinants for CrossFit performance.[32,33,40] Glassman stated that the CrossFit program was more effective in gaining strength than the fitness program in the Canadian army.[41] In the study of Goins conducted on some physical and physiological variables of 6-week CrossFit training, they stated that there was a significant improvement in the deadlift, squat, and shoulder press values.[17] Dilber and Doğru reported that CrossFit-based HIFT (high-intensity functional training) training was significantly effective on the right and left-hand claw strength, leg strength, and back strength in their study with the participants with an average age of 23.62 ± 5.39 years.[20] Yüksel et al., stated that the 8-week Cindy CrossFit study was effective in strength development.[21] Perna et al., compared high-intensity CrossFit training with high-intensity swimming training and reported an increase in muscle strength of the CrossFit group.[42] Heinrich et al., stated that there was a significant change in lower extremity strength as a result of CrossFit training, which resembles a 5-week high-intensity functional training, in the group whose age range was between 35-65.[38] On the other hand, Gerhart compared traditional resistance training with CrossFit training and stated that the strength values were higher in the CrossFit group.[43] When compared according to the results of the differences between the first and last measurements of our study, it is in parallel with the literature. In addition to that, strength development was observed in both CrossFit models. However, the increase in back squat values was higher in the CrossFit AMRAP model. Brisebois et al., in their study, stated that there was a significant increase in 1 min. sit-up values in female and male participants after the 8-week CrossFit program.[44] In the study conducted by Nikić and Milenković, they observed that there was a significant increase in crunch and push-up values after 12 weeks of functional training.[45] In the research conducted by Beilke et al., on 16 healthy adult male individuals between the ages of 19-25, they stated that there was a significant increase in 1 min. push-up values after 4-week CrossFit training implementation.[46] Cosgrove et al., stated that there was a significant increase in 1 min. push-up values at the end of the 16-week CrossFit-based high-intensity functional training (HIFT) training period for male students studying at university in 2013-2014.[47] Eather et al., reported that CrossFit training affected vertical jump performance.[48] Schafer et al., stated that the increase in vertical jump performance and anaerobic power value of participants with an average age of 18 who had performed CrossFit training with ROTC for 12 weeks was not statistically significant.[49] Yüksel et al. stated that the 8-week Cindy CrossFit study was effective on jumping performance.[21] Sparkles and Behm reported that stable and unstable CrossFit methods provided similar improvement in jump performance.[50] In the study of Goins investigating the effects of 6-week CrossFit training on some physical and physiological variables, they reported that there was no effect on vertical jump values.[17] In our study, the improvement results in 1 min. push-up and vertical jump values in our study showed parallelism with the literature in terms of process depending on the training period. The change in 1 min., crunch values showed improvement as training effect. From this aspect, it was observed that the level in 1 min. push upvalues in the CrossFit AMRAP model was higher than the Classic CrossFit model. That CrossFit AMRAP model got better results in performance increase in strength-related endurance and the vertical jump was evaluated because of the increase in the number of repeated actions against the time spent at the stations in the process.

6. CONCLUSIONS

As a result, the numerical increase in some performance values of the AMRAP CrossFit training group after 8 weeks of work was more prominent than the classical CrossFit training group. In addition, AMRAP CrossFit training was shown to contribute more to a reduction in body weight. It was determined that both models had a positive effect on their strength capacity effectively. Because AMRAP is a more anaerobic performance than CrossFit, it had a greater impact on a sport where the anaerobic energy system was dominant, such as wrestling. In the AMRAP model, the number of effective repetitions which were performed during the implementation of the movement can negatively affect the quality of the output against the high-level resistances. CrossFit training stands out with its functional training approach for the whole body. Among the types of wrestling, the whole body is used during the competition following the rules in freestyle. Therefore, while applying for CrossFit training programs, the basic bio motor characteristics of the sports branch should be considered.

7. AUTHORS CONTRIBUTION STATEMENT

The collected data and data extraction is done by O.Yüksel, A.Türker contributed to completing the analysis. In addition, A.Türker and O. Yüksel did the final writing. All the authors read and approved the final version of the manuscript.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

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