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The Effect of High-Intensity Functional Exercises on Anthropometric and Physiological Characteristics in Sedantery

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Abstract

Aim: Group-based training through Crossfit has recently exploded in popularity. When the effects of Crossfit trainings on many basic component are considered, the aim of this study is to investigate the effects of high-intensity functional trainings on anthropometric and physiological characteristics of sedentary individuals.
Methods: Their age averages are 23.62±5.39 (year), height averages are 177±0.06 (cm) and body weight averages are 79.88±12.14 (kg). Crossfit training system was applied during high-intensity functional exercise planning at four days a week, for twelve weeks. Body weight, body fat percentage, body mass index (BMI), blood pressure, resting heart rate, hand grip strength, back strength, leg strength measurements were taken from the participants. Statistical analyses were done with SPSS 15.00 statistical package program.
Results: In pre-test and post-test measurements, it was found that there are statistically significant differences between the participants' body fat percentage, systolic blood pressure, diastolic blood pressure, left and right-hand grip, back strength and leg strength values ($p<0.05$).
Conclusion: As a result, it can be said that these high-intensity exercises that were applied has positive contribution to anthropometric and physiological characteristics in sedanteries.

Keywords
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Crossfit,
High-intensity exercise,
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INTRODUCTION

Crossfit was firstly established by Greg Glassman who was both fitness instructor and gymnast in California/Santa Cruz in 1995. It was published as a webcast in 2001 (Glassman, 2010). Crossfit is regarded as one of the fastest growing models of high-intensity functional training. Since its development in the 1990s, around the world, it has became competitive sports that more than 200.000 athletes participated in almost 11.000 gym (Maté-Muñoz, Lougedo, Barba, García-Fernández, Garnacho-Castaño & Domínguez, 2017).

Crossfit has 10 basic components including incidence, agility, balance, coordination, cardiovascular endurance, flexibility, power, speed, endurance and strength (Glassman, 2002). Crossfit Training, is a general power and condition program (Moran, Booker, Staines & Williams, 2017). This program was firstly improved for military training but it has become increasingly common among the civil society (Bergeron, Nindl, Deuster, Baumgartner, Kane, Kraemer, et al., 2011; Claudino, Gabbett, Bourgeois, de Sá Souza, Miranda, Mezêncio, et al., 2018). Crossfit Training is generally high-intensity strength exercises (Hak, Hodzovic & Hickey, 2013; Larsen & Jensen, 2014). This training type is fastly, repeatedly done or it is done as limited between sets or without any rest (Butcher, Neyedly, Horvey & Benko, 2015). It is seen that individuals participating in regular Crossfit training has showed progression in muscle endurance and strength over time (Glassman, 2006). Crossfit is basically a training model in which high-intensity functional exercises are combined with cardiovascular exercises and gymnastics, body weight and weights are done (Greg Glassman, 2010; Sibley, 2012). Programs are generally in "workout of the day" (WOD) format. WOD consists of different, functional movement patterns. It can be scaled regardless of participants' strength and fitness levels (Eather, Morgan & Lubans, 2016).

Trainings widely vary and constantly change. There are three models according to the training content: gymnastics, metabolic conditioning and weightlifting. Gymnastics model were designed for improving body control. It includes squats, push-ups, pull-ups, rope climb, rings or parallel bars done by using body weight. Metabolic conditioning model was designed to create fatigue in response to less resistance. Exercises can be aerobic or anaerobik and sets are designed as interval training (high-intensity training with resting sets). Running, rowing, rope climbing, swimming and biking can be given as an example. Weightlifting model consists of external load exercises like squat and deadlift. While

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some of these exercises aim to get best possible time, some of them aim to make more sets with 10-20 minutes breaks (Babiash, Porcari, Steffen, Doberstein, & Foster, 2013; Maté-Muñoz et al., 2017).

In recent years, the participation rates of sedentary individuals in physical activity have been gradually increasing. Therefore, activities and the needs that people preferred change and they tend to prefer different activities (Klimek, Ashbeck, Brook & Durall, 2017; O'Hara, Serres, Traver, Wright, Vojta & Eveland, 2012; Thompson, 2014). Now, instead of classical isotonic devices, more functional and natural exercise needs arise. When the effects of Crossfit trainings on many basic component are considered, the aim of this study is to investigate the effects of high-intensity functional trainings on anthropometric and physiological characteristics of sedentary individuals.

METHOD

Participants

30 sedantary men with a mean age of 23.62 ± 5.39 (years) who regularly go to the gym by the name of Fgym Sports located in Manisa and have no health problems participated in this study. Participants were informed about the aim and content of the study, and written informed consent was obtained from each subject before initiating any research procedures. The revised version of the Physical Activity Readiness Questionnaire (PAR-Q) developed by Canadian exercise experts was used to identify the risk factors of participation in physical activity and to determine whether they need to get medical advice before starting regular physical activity or not (Shephard, Cox & Simper, 1981). The questionnaire consists of 7 Yes/No question. If the participant says "Yes" for one of the questions, he needs to be send to doctor control.

Training Protocol: CrossFit Training system was applied during high-intensity functional exercise planning at 4 days a week, for 12 weeks. Before the training programs, the participants were firstly given technical training and provided to work at right angles. The participants had worked with expert trainers during the program. The training program were totally applied in 60-75min. that consisted of warming up in 15min., main part in 30-45min. and cooling down in 15 minutes. After the two day training program, one full day rest was given. The trainings were held between 18.30 and 19.30 p.m.

The training program was applied by 3 different WOD. WOD1 consisted of 500 m Row, 40 Wall Balls, 30 Pushups, 20 Box Jump and 10 Thruster. WOD2 consisted of 5 Burpees, 10 Kettlebell Swing and 15 Air Squat (AMRAP 15min). WOD3 consisted of 5 Hang Power Clean, 5 Front Squat, 5 Jerk and 5 Dead Lift in 5 set.

Table 1. Training Program

WOD 1	WOD 2	WOD 3
For Time	15 min AMRAP	5 Times
500 m Rowing	5 Burpees	5 Hang Power Clean
40 Wall Ball	10 Kettlebell Swing	5 Front Squat
30 Push Ups	15 Air Squat	5 Jerk
20 Box Jump		5 Dead Lift
10 Thruster		

Anthropometric and Physiological Measurements: All tests and measurements were applied in the measuring and evaluation area of the gym. Body composition measurements of the participants were done with a body composition analyzer (Tanita 300 MA, Tokio-Japan) working with the bioelectrical impedance method. Body fat percentage were measured with the Skinfold Caliper in 4 areas (biceps, triceps, iliac and subscapular). Blood pressure and resting heart rate measurements were taken after resting for 5 minutes in a sitting position with the tension measuring device (Littmann, Classic II S.E, 3M Healthcare, USA).

Body fat percentage measurements were made using the 'Holtain Skinfold Caliper' in 4 regions (triceps, subscapularis, suprailiac, abdominal) with 1mm precision and calculated by Yuhasz method (% fat=5.783+0.153 (triceps+subscapular+suprailiac+abdomen) (Medicine, 2013). Body fat percentage was measured twice for each part and averaged. When the values of 2 measurement were different from each other with 0.5 mm, it was averaged by taking the 3rd measurement.

***Back Strength Test**:* The back strengths of the athletes were measured by Takei (Japan) back and leg dynamometer. After the athletes put their feets on the dynamometer table while their knees were stretched, they vertically pulled up the dynamometer bar in the maximum rate with their hands while their arms were stretched, back were straight and the body slightly inclined forward. This test was applied three times and the best value was recorded (Aslan, Büyükdere, Köklü, Özkan & Özdemir, 2011).

Leg Strenght Test: The leg strength measurement was taken by Takei (Japan) back and leg dynamometer. In many sources, it is stated that dynamometers are used for determining strength. The participants applied the test by putting their feets on dynamometer table while their knees were stretched, and vertically pulling up the dynamometer bar by using their legs in the maximum rate while their arms were stretched, back were straight and the body slightly inclined forward (Aslan et al., 2011).

Hand Grip Strength Test: Hand grip strength tests that is the function of both muscles in hand and forearm were done by using Takei (Japan) hand dynamometer. Hand grip strength test was performed while the participants were standing. This test was repeated three times and the best value was recorded (Aslan et al., 2011).

Statistical analysis

Statistical analyses were done with SPSS 15.00 statistical package program. Normal distribution fitness of the data was analyzed with the Shapiro-Wilk W Test and all data show normal distribution. The Paired-t Test was used to compare first and final tests. The descriptive data of the participants were shown as minimum, maximum, average and standard deviation. Significance value was accepted as $p<0.05$.

RESULTS

The minimum, maximum and average values of the age, height and body weight of the participants were showed in Table 2.

Table 2. Descriptive parameters of the participants

Parameters	Min-Max	Mean±SD
Age (year)	15.00-34.00	23.62±5.39
Height (cm)	165.00-193.00	177±0.06
Body Weight (kg)	62.80-115.20	79.88±12.14

The first and final test values of the participants were compared in table 3. According to this, in body fat percentage (p=0.003), systolic blood pressure (p=0.027), diastolic blood pressure (p=0.040), right hand grip (p=0.034), left hand grip (p=0.001), back strength (p=0.001) and leg strength (p=0.000) statistically significant difference was found.

Table 3. Comparison of the first and final values of the participants

Parameters	Pre-Test		Post-Test		P
	Min-Max	Mean±SD	Min-Max	Mean±SD	
Body Weight (kg)	62.80-115.20	79.88±12.14	63.20-105.60	79.01±10.85	0.091
BMI (kg/cm^2)	18.70-37.20	25.29±4.04	19.20-34.10	25.02±3.60	0.052
Body Fat (%)	8.10-34.80	20.57±5.51	10.50-28.30	18.95±4.63	0.003*
Systolic Blood Pressure (mm/hg)	106.00-175.00	135.31±14.93	98.00-168.00	131.81±13.72	0.027*
Diastolic Blood Pressure (mm/hg)	49.00-102.00	77.18±12.54	55.00-93.00	72.93±10.80	0.040*
Resting Heart Rate (pulse/min.)	53.00-110.00	80.78±12.86	44.00-100.00	76.78±12.02	0.090
Right Hand Grip (kg)	29.00-56.10	44.13±5.93	34.00-61.90	46.25±6.04	0.034*
Left Hand Grip (kg)	28.00-50.90	39.99±5.71	30.30-57.00	43.29±6.20	0.001*
Back Strength (kg)	65.00-144.00	117.94±17.57	91.50-167.00	129.68±17.14	0.001*
Leg Strength (kg)	62.50-181.50	115.73±23.19	84.00-168.50	125.92±21.13	0.000*

*p<0.05

DISCUSSION

In parallel with the increasing popularity of high intensity exercise training, studies are also increasingly being conducted to determine the safety and effectiveness of such training methods. In this study, the

effects 12-week high-intensity functional training on anthropometric and physiological characteristics of 30 sedanter male participants with a mean age of 23.62±5.39 (years) were investigated. When the first and final test values of the participants were compared; statistically significant difference was found in body fat percentage (P<0.003), systolic blood pressure (p<0.027), diastolic blood pressure (p<0.040), right hand grip (p <0.034), left hand grip (p<0.001), back strength (p<0.001) and leg strength (p<0.000). A decrease, although it was not significant, was found in resting heart rate (p>0.090), body weight(p>0.091) ve BMI (p>0.052).

Over the past few years, Crossfit Training has become very popular in the society for individuals who want to lose weight and gain form (Goins, 2014). Crossfit exercises were designed to put the stress in the metabolic system by combining various exercise movements, intensity, resistance, repetitions, sets, and rest intervals into a session (Kliszczewicz, Snarr & Esco, 2014). Gregory, Hamdan, Torisky and Akers, (2017), 26 volunteers with a mean age of 34.58±9.26 were applied a combination of low-carbohydrate ketogenic diet and Crossfit training once a week during 6 weeks. When it was compared with the control group; a significant decrease was reported in BMI (0.07±0.43,-1.13±0.70kg/m^2), body weight (0.18±1.30,-3.45±2.18kg), body fat percentage (0.01±1.21,-2.60±2.14%) ve fat percentage (0.06±1.12,-2.83±1.77kg) of the diet group. However, it was reported that there were no difference in vertical jump, long jump, and total performance time (Gregory et al., 2017). Smith, Sommer, Starkoff, and Devor, (2013), Crossfit based high-intensity strength program and diet program was applied together to 43 volunteer female and male participants during 10 week. Their body fat percentages decreased by %3.7 over 10 week (p=0.00008) (Smith et al., 2013). Despite the fact that the program in our study was not applied with diet, a decrease in fat percentage by %7.8 was determined (p<0.003). We assume that this result comes from the training protocol that we applied. Murawska-Cialowicz, Wojna, and Zuwala-Jagiello, (2015), it was determined that 3-month Crossfit training program applied in 2 days of a week and during 60 minute showed a significant decrease in fat percentage in women with a mean age of 24.0 ± 1.82 and a body weight average of 59.25±5.7kg (p=0.05) (Murawska-Cialowicz et al.,). Yüksel, Erzeybek, Kaya and Gülaç, (2017), 33 physically active, female volunteer and universty students between the age of 18-24 years were applied strength training in 3 times of the week during 6 weeks. After six weeks training; it was found that the body weight, body fat percentage and BMI of the Crossfit group significantly decreased (Yüksel et al., 2017). In our study, there was a decrease- although it was not significant- in body weight, body fat percentage and BMI of the participants. Heinrich et al. (2015), volunteers between the ages of 35 and 65 were applied high-intensity functional training in 3 times a week for 5 weeks. As a result, it was reported that there was statistically significant increase about +3.8±2.1 kg in fat-free body weight (p=0.008) and significant decrease about-3.3±1.0 kg (p=0.001) in body fat, -4.7±1.2 in body fat percentage (p<0.001). Additionally, there was a significant difference in lower extremity strength and power (p=0.009) (Heinrich, Becker, Carlisle, Gilmore, Hauser, Frye et al., 2015). In our study, the increase in the leg strength and the decrease in the fat ratio show similarity with the studies in the literature.

Physiologically, the muscle-nerve capacity which resists internal and external resistance and overcomes these effects is expressed as force (Güllü & Güllü, 2001). In addition to high-intensity intermittent exercises, the basis of the Crossfit consists of high-intensity strength training. These exercises involve multiple joint movements and it seems that they increase body composition and strength development. Crossfit training is a method that focuses on total body strength and endurance, rather than developing a specific skill of the body. It defends multi-articulated movements against traditional methods (Smith et al., 2013). Crossfit trainings are high-intensity strength exercises. This training is done in a fast, repetitive way and there are limited rests or any rest between the sets. Therefore, it is seen that there is a development in muscle endurance and strength of the participants who regularly attend Crossfit trainings over the time (Yüksel et al., 2017). Gerhart and Pasternostro Bayles, (2014), compared traditional resistance training with Crossfit training. It was reported that there is a significant difference in maximal strength values on the behalf of Crossfit (Gerhart & Pasternostro Bayles). Barfield, Channell, Pugh, Tuck and Pendel, (2012) It was determined that there were not significant difference in BMI and hand grip strength after the Crossfit training applied to 60 volunteers (Barfield et al.,). Eather et al., (2016), Crossfit training was applied to 96 students with an average age of 15.4 during 60 minutes, in twice a week for 8 weeks. It was reported that there were not any significant difference between girls (p=0.21) and boys (p=0.10) in hand grip strength (Eather et al.,). In our study, there was

a statistically significant difference in left and right hand grip strength ($p<0.05$). This difference might come from the training protocol that we applied and the period. Shaw et al. (2015), it was reported that there were not significant difference in one session Crossfit training, systolic blood pressure ($p=0.450$) and diastolic blood pressure ($p=0.844$) (Shaw, Dullabh, Forbes, Brandkamp, & Shaw, 2015). The significant difference in both systolic and diastolic blood pressure of our study may be result of the regular application of the program during 12 weeks.

CONCLUSION

It is possible to talk about possitive strength, anthropometric and physiological effects of the hight - intensity functional training program applied 4 times a week in sedantary individuals at for 12 weeks.

PRACTICAL APPLICATION

When the negative effects of the sedentary lifestyle on the individual are considered, the training program that we applied can be suggested to sedantary individuals. Trainers and personal trainers can attach the training program that we applied to their own studies.

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