The Effects of Different Types of Strength Training for Recreational Purposes on the Body Composition and Strength Development of University Students

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Abstract

The aim of this study was to investigate the effect of CrossFit and resistance training on maximal strength, isometric strength and strength continuity in recreational student athletes. 28 healthy male volunteer students who were doing sport for recreational purposes participated in the study. After the participants were randomly divided into two groups, strength tests were performed and body composition measurements were taken before and after the 16-week training period. Bench press and squat were applied to determine maximal force; leg and handgrip strength were applied to determine isometric force; pull-up and push-up tests were applied to determine the continuity of strength. Body composition measurements were performed with electronic scales. Statistical analyses were performed with SPSS 21.0 program. Significance level was accepted as p<0.05. The CrossFit training program included consecutive 5 pull-ups, 10 push-ups and 15 squat exercises for 20 minutes (CrossFit-Cindy). Resistance training program consisted of 3 sets of bench press, lat pull down, leg press, biceps curl and triceps extension exercises with 3 minute intervals using 70% of the weights the participants could perform with pre-determined maximum 1 repetition. The results of the study showed that body fat percentages of both groups decreased significantly, performance variables increased significantly and body weight did not change significantly. In addition, the increase in push-up exercise was higher in the CrossFit group than in the resistance group. Thus, this study shows that although CrossFit training is short-term, it can be used as an alternative to classical resistance training.

Keywords: Cross Fit, Resistance exercises, Strength, Body composition, Recreational, Training.


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Ethical: This study follows all ethical practices during writing.
Contribution of this paper to the literature
This study contributes to the existing literature by investigating the effect of CrossFit and resistance training on maximal strength, isometric strength and strength continuity in recreational student athletes.

1. Introduction
Recreational sports are activities which are done to meet the individual's needs (entertainment, health, aesthetics, psychological) without expecting any performance output (professional success). The content of recreational sports may vary according to the individual's expectations. Some individuals take part in activities that include recreational hiking, water sports, extreme sports, team or individual sports, while others prefer the fitness center. In all of these regular activities, the individual gets positive physiological and psychological benefits. Regular activities, especially those done in fitness centers, result in an increase in strength output.

Strength is an important component in many sports (Ribeiro et al., 2017; Colquhoun et al., 2018; Rajkumar and Divya, 2018). Resistance exercises, which are mostly preferred for strength development, are frequently used in sports sciences, especially in research designs where the effects of any intervention, such as training, are examined (Weir, 2005; Ritti-Dias et al., 2011; Özbay and Ulupinar, 2018).

CrossFit® (CrossFit, Inc., Washington, DC, USA) is a high intensity functional training model that has become very popular in recent years (Butcher et al., 2015). CrossFit is one of the fastest growing functional methods of high intensity training. It is thought that more than 200,000 athletes participate in CrossFit training in approximately 11,000 gyms (Maté-Muñoz et al., 2018).

When the literature was examined, significant benefits of CrossFit trainings were found on health and wellness (Glassman, 2006; Sparkes and Behm, 2010; Kliszczewicz et al., 2014; Fernández et al., 2015; Eather et al., 2016; Sousa et al., 2016; Yüksel et al., 2019). CrossFit training also affects both aerobic and anaerobic performance (Smith et al., 2013). Basically, CrossFit is a training model in which high-intensity functional exercises are combined with cardiovascular exercises and gymnastics, body weight and weights (Glassman, 2010; Sibley, 2012; Gregory et al., 2017). Programs are usually in the form of "workout of the day" (WOD). WOD consists of different, functional motion models. They can be scaled regardless of the participants’ strength and form level (Eather et al., 2016; Dilber and Doğru, 2018). High intensity interval training and body weight workout ranks among the top three in 2017 worldwide sports trend list (Thompson 2017).

There are many factors affecting strength and development. One of these factors is the proportion of body fat and body fat percentage. Strength training not only increases muscle resistance, but also regulates the composition of the body. Two muscles with the same circumference and volume produce different amounts of strength due to the different fatty tissue they contain. Fat impedance not only reduces the contraction force but also limits the size and speed of contraction of the muscle fibres by creating friction (viscosity). As a result, excess fat in the body means extra burden as it will cause extra energy consumption to transport fat for performance (Tamer, 1991; Yüksel et al., 2017).

The aim of this study is to examine the effects of CrossFit and resistance training on maximal strength, isometric strength, strength continuity and body composition in students who do sport for recreational purposes and to show whether these training methods are alternative for each other.

2. Method
2.1. Participants
28 healthy male volunteer students doing sport for recreational purposes participated in the study. After the participants were divided into groups, the differences between anthropometric measurements and ITM loads were tested and if the difference was significant, the groups were randomly redistributed. The participants were randomly divided into two groups [CrossFit Group (n=14), Resistance Group (n=14)]. Strength and anthropometric measurements were performed before and after the 16-week training period. The participants did not receive any additional food or nutritional supplements during the training period. They were selected on a voluntary basis from individuals without temporary disability or disease. They were provided with detailed explanations and they signed informed consent prior to volunteering for the study. All this process was conducted according to the Helsinki Declaration.

2.2. Anthropometric Measurements
The height of the participants were measured by stadiometer (Holtain Ltd., UK); weight, body mass index (BMI) and body fat percentage (BF%) were measured by bioelectrical impedance analyser (Tanita TBF 401, Japan).

2.3. Strength Tests
Maximal dynamic strength of participants was measured using one repetition squat and bench press test. The wrestlers performed 3 trials for both test at 3-min intervals. The load was increased by 3-10% in valid trials or reduced by 3-10% in invalid trials according to the request of the participants. For a trial to be considered valid, it was based on completing a full range of motion and returning to the starting position.

Isometric strengths of participants were measured via relevant dynamometers (Takei A5001 Hand Grip Dynamometer and Takei A5002 Leg Dynamometer, Tokyo, Japan). Dominant hand was preferred during the hand grip strength test. During the leg strength test, the pull-bar of the dynamometer was placed in the hands and the angle of the knees was set at 45 degrees. In both tests, the highest score from two trials with 3-min rest intervals was considered valid.

Strength endurance performances of participants were determined via pull-up and push-up tests. For the pull-up test to be valid, the total number of repetitions the participant was able to pull the chin above the constant bar were calculated. For the push-up test to be valid, the total number of repetitions the participant was able to complete full range of motion and to return to the starting position were calculated.
1TM loads of the participants were determined on two different days after a practice workout. Rest periods of 2-3 days were used between these exercises. On the first day, 1TM loads of bench press and squat exercises were determined. On the second day, the same tests were repeated to ensure test-retest reliability. The higher load between the two test days was determined as the valid 1TM load. For each exercise, participants were given 5 rights with 5 minute intervals. The other exercise was started after a rest of at least 10 minutes. The same procedure was reapplied after 16 weeks of training to determine performance improvement.

2.4. Workout Protocols
CrossFit workout program was applied to the participants as Cindy model three days a week for 16 weeks. The workouts were made for 20 minutes without rest as consecutive 5 pull-ups, 10 push-ups and 15 squat exercises with body weights (Butcher et al., 2015). All workouts were observed by the researcher.

Resistance training. Resistance training group received resistance training for 16 weeks. Workouts were done three times a week. In resistance training, bench press, lat pull down, leg press, biceps curl and triceps extension exercises were applied in 3 sets with 3 minute intervals. The subjects attempted to achieve maximum repetition in 70% of their 1TM load while performing the exercises. Before starting the exercises, the subjects performed a warm-up of 15 repetitions in 50% of their load. All workouts were observed by the researcher.

2.5. Statistical Analysis
Statistical analyses were performed with SPSS 21.0 program. Significance level was accepted as p <0.05. Mean and standard deviation were used for data analysis. Independent t-test was used to determine whether there was a difference between the groups at the beginning of the study. Paired t-test was used to determine the difference between the measured values of a group before and after the research period. In addition, two-way ANOVA test was used for repeated measurements to determine the group X time (before-after) interaction.

3. Findings

Table 1. Descriptive and performance features of the participants (N=28).

<table>
<thead>
<tr>
<th>Descriptive and performance</th>
<th>CrossFit Group (n=14)</th>
<th>Resistance Group (n=14)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>20.8 ± 2.0</td>
<td>19.7 ± 1.8</td>
<td>1.475</td>
<td>0.152</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>171.4 ± 10.2</td>
<td>170.1 ± 9.2</td>
<td>0.550</td>
<td>0.572</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>66.5 ± 9.3</td>
<td>66.2 ± 9.9</td>
<td>0.074</td>
<td>0.941</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>21.2 ± 1.0</td>
<td>21.1 ± 2.6</td>
<td>0.941</td>
<td>0.372</td>
</tr>
<tr>
<td>Fat%</td>
<td>9.1 ± 2.3</td>
<td>10.5 ± 3.0</td>
<td>1.383</td>
<td>0.178</td>
</tr>
<tr>
<td>BP (kg)</td>
<td>70.1 ± 10.1</td>
<td>69.7 ± 11.3</td>
<td>0.168</td>
<td>0.390</td>
</tr>
<tr>
<td>SQ (kg)</td>
<td>106.3 ± 14.9</td>
<td>105.9 ± 15.9</td>
<td>0.075</td>
<td>0.491</td>
</tr>
<tr>
<td>LS (kg)</td>
<td>143.3 ± 22.9</td>
<td>136.6 ± 23.0</td>
<td>0.765</td>
<td>0.451</td>
</tr>
<tr>
<td>HGS (kg)</td>
<td>38.0 ± 3.9</td>
<td>41.0 ± 6.2</td>
<td>1.014</td>
<td>0.119</td>
</tr>
<tr>
<td>push-up (repetition)</td>
<td>15.6 ± 3.1</td>
<td>14.6 ± 2.2</td>
<td>1.318</td>
<td>0.189</td>
</tr>
<tr>
<td>pull-up (repetition)</td>
<td>31.6 ± 6.9</td>
<td>34.8 ± 5.6</td>
<td>1.041</td>
<td>0.307</td>
</tr>
</tbody>
</table>

Values were presented mean ± SD
BP = bench press; SQ = squat; LS = leg strength; HGS = handgrip strength

Table 2. Performance values of the participants before and after 16 weeks training period (N=28).

<table>
<thead>
<tr>
<th>CrossFit Group (n=14)</th>
<th>Resistance Group (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>66.5 ± 9.3</td>
</tr>
<tr>
<td>Fat%</td>
<td>9.4 ± 2.3</td>
</tr>
<tr>
<td>BP (kg)</td>
<td>70.1 ± 10.1</td>
</tr>
<tr>
<td>SQ (kg)</td>
<td>106.4 ± 14.9</td>
</tr>
<tr>
<td>LS (kg)</td>
<td>143.2 ± 22.9</td>
</tr>
<tr>
<td>HGS (kg)</td>
<td>38.0 ± 3.9</td>
</tr>
<tr>
<td>push-up (repetition)</td>
<td>15.6 ± 3.1</td>
</tr>
<tr>
<td>pull-up (repetition)</td>
<td>34.7 ± 5.6</td>
</tr>
</tbody>
</table>

Values were presented mean ± SD.
* There is significant difference before and after values.
# Group X time (before-after) interaction is significant.
BP = bench press; SQ = squat; LS = leg strength; HGS = handgrip strength

Anthropometric measurements and performance values of the participants were monitored before and after the 16-week training period Table 2. While both groups showed a significant increase in all performance variables; body fat percentages decreased significantly; however, there was no significant change in body weight. In addition, the increase in push-up variable in the CrossFit group was significantly higher than the increase in the resistance group.

4. Discussion and Conclusion
The number of students doing sports for recreational purposes is increasing day by day. “CrossFit”, which includes various types of workout, is a serious alternative for students doing recreational sports. This study was conducted to investigate the effect of CrossFit and resistance training on maximal strength, isometric strength and strength continuity in recreational student athletes and to show whether these training methods can be an
alternative for each measurement. Anthropometric and performance values of the participants were monitored before and after the 16-week training period Table 2. While there was a significant increase in all performance variables in both groups; a significant reduction was found in body fat percentages. However, there was no significant change in the body weight of the participants. In addition, it was found that the increase in push-up variable in the CrossFit group was significantly higher than the increase in the resistance group.

When studies about resistance training were examined, both CrossFit and classic resistance training methods were shown to have positive effects on body composition and strength increase. In their study, Murawska-Ciałowicz et al. (2015) stated that three month long CrossFit workout preformed with 15 young female participants decreased body fat percentage significantly (Murawska-Ciałowicz et al., 2015). Fatoba (2016) found that the decrease in body fat percentage was significant at the end of 12-week-long circular resistance training program applied five times with 60 participants (Fatoba, 2016). In a study in which 6-week-long layout strength training methods were applied on 35 female participants, Yüksel et al. (2017) reported that the decrease in body composition in both CrossFit and definition training program was significant (Yüksel et al., 2017). In a study conducted on young men and women, Uçan et al. (2018) found significant change in body fat ratio as a result of 10-week resistance training, while no significant change was found in body weight and BMI (Body Mass Index) (Uçan, 2018). In their study they applied CrossFit-based high intensity strength program, Smith et al. (2013) found 5.7% decrease in body fat percentage (Smith et al., 2013). According to the results of our study, it is thought that the greater decrease in fat ratio is due to the intensity of workout protocols and the differences in diets applied in the study. In their study they compared CrossFit training method and classical resistance training, Gerhart and Pasternostro (2014) found that the difference between was significant in favour of CrossFit (Gerhart and Pasternostro, 2014). On the other hand, in their study which included 60 participants, Barfield et al. (2012) did not find a significant difference in body mass index (BMI) strength (Barfield et al., 2012). In their week they applied CrossFit workout method, Dilber and Doğru (2018) reported a significant increase in body fat percentage, left and right grip and leg strength of the participants (Dilber and Doğru, 2018). In their study they applied CrossFit (Cindy) workout program on 32 participants for 8 weeks, Yüksel et al. (2019) found that this method developed strength ability (Yüksel et al., 2019).

In conclusion, it can be seen that both training methods have positive effects on body composition and strength. When it is considered that CrossFit training method, which has become very popular recently, can be designed for different purposes and is practical and saves time, it is thought that it is a serious alternative to resistance training in today’s world.

References


