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The Effect of Core and Plyometric Exercises on Soccer Players

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ABSTRACT The objective of this study is to examine the effects of core and plyometric exercises on some motoric capabilities of soccer players. 30 soccer players who play for Mugla University S.C. participated in the research study. In the research, core and plyometric exercises were implemented on two different groups for 8 weeks, but within a 30-35 minutes time frame and on twice a week basis. Before the implementations, pre-test results of the two groups of 15 players were obtained. For 8 weeks, plyometric strength training exercises were implemented on the 1st experimental group whilst, core strength training exercises were implemented on the 2nd experimental group. After 8 weeks, post-test measures of the two groups were obtained. Statistical differences between tests were analyzed with t-test. The significance level was taken as $p<0.05$. In conclusion, it was observed that 8-week core exercises implemented on soccer players who play in Amateur League have been more effective in jumping and in some motoric capabilities than the plyometric exercises.

INTRODUCTION

On the issue of which strength training method is more convenient for soccer training, primarily and certainly, it can be stated that the strength training methods do not depend only on the number of units per training done during soccer exercises (Weineck 2011).

Plyometric exercises are defined as the exercises and drills that employ the combination of speed and strength to increase relative explosive movements (Chu 1992; Pienaa and Coetzee 2013; Behrens et al. 2014), and are used to develop strength (Agaoglu et al. 2000; Potdevin et al. 2011; Piirainen et al. 2014). In plyometric exercises, it is believed that, keeping the time between the eccentric and concentric contractions short and therefore turning elastic energy turning into mechanical energy faster, together with decreasing the loss of heat transformation increases the sportive efficiency (Kin 2000; Houghton et al. 2013; Sannicandro et al. 2014).

The area named as "core" is the area including the abdominals in the front side of the body. In other words hypochondrium and hypogastrium muscles; serratuses is right next to hypochondrium muscles; obliques is right next to hypogastrium muscles; and the muscle groups from the waist to the neck that help the skeleton to have a correct posture (External Obliques, Internal Obliques, Transversus Abdominis, Multifidi Psoas). "Core training" refers to the training of the above mentioned abdominal and lumbar regions. Strengthening the core region is not only necessary for sportive endurance but it also provides a correct posture (Fahey et al. 2011; Weston et al. 2013; Qianyun et al. 2013; Weston et al. 2014).

In addition, vertical jumping ability is one of the most important elements for a successful performance in many branches of sports. Many sport-specific techniques are implemented with single or double foot jumping (head-shot in soccer, jumps in athleticism, block in volleyball or rebound in basketball etc.). In developing strength and jumping skills and providing the adaptation of central nervous systems, explosive strength trainings are very important place (Milic et al. 2008; Piirainen et al. 2014). In sports branches that require deflections like soccer, elastic and quick strength are the indicators of performance (Acikada and Ergen 1990). Trainers use plyometric training types to improve elastic strength, jumping efficiency and leg strength (Dolu 1994; Houghton et al. 2013).

The purpose of the present research is to examine the effects of core and plyometric strength exercises among many methods that develop strength in soccer players, and used by trainers frequently on some motoric capabilities of soccer players.

MATERIAL AND METHODS

In the present research, pre-test and post-test patterned experimental method was used. On the experiment groups, plyometric and core exercises were implemented for 8 weeks in 2012-

2013 soccer season. The average age of the participants is X= 21.12±2.35 years and their body weight average is X=76.22±4.37 kg. All the measurements related to the research were taken by experts in the Physiology Laboratory of Mugla Sitki Kocman University, School of Physical Education and Sports.

Plyometric and Core Groups

Thirty certified soccer players who actively play in Mugla University Sports Club voluntarily participated in the research; plyometric exercises were implemented on the 1st group (n=15), and core exercises were implemented on the 2nd group (n=15). Required permissions were received from the related institutions. Eight (8)-week plyometric and core exercises were implemented in Mugla Sitki Kocman University School of Physical Education and Sports soccer field on Tuesdays and Thursdays.

Preparation and Implementation of Experiment Tools

Before the implementations, pre-test measurements (height-weight, flexibility, leg strength, back strength, hand grip strength and vertical jumps) were taken. For Eight (8)- weeks, 6 station plyometric exercises were implemented on the 1st experiment group and, 6 station core exercises were carried out on the 2nd experiment group. After 8 weeks, post-test group measurements were taken in Mugla Sitki Kocman University School of Physical Education and Sports Physiology Laboratory.

Measurement Vehicles

The vehicles used in measurements are presented below.

Weight and Height Measurement

Seca brand electronic scale was used. During the measurement, the participants were barefooted, heels were adjacent, the body and the head were high, eyes were looking straight, and arms were hanging free on both sides. Measurements were taken in kg for weight, and cm for height. Sit and reach flexibility box was used in measurements. The feet of the soccer players were placed under the box so that they were in complete contact with the box, and the measurement of the farthest point their hands reached were taken.

Leg-Back Strength Measurement

Takei brand back and leg dynamometer was used. For leg strength measurement; players placed their feet on dynamometer table in knees bent position and grabbed the dynamometer bar with arm stretched, back straight and body slightly bent over position and pulled the bar by lifting their legs as much as they could; before the measurements were taken. For back strength measurement; players placed their feet on dynamometer table in knees stretched position and grabbed the dynamometer bar with arms stretched, back straight and body slightly bent over position and pulled the bar up vertically as much as they could and the measurements were taken.

Grip Strength Measurement

Takei brand hand grip dynamometer was used. The participants were standing and the measured arm was in 45 degree angle and the measurements were taken with a complete grip procedure without bending the arm.

Vertical Jump Measurement

In this type of exercises, the players jump forward and vertically. The exercise starts in squad position, and jumps are done one after another. The movements were done with maximal effort and complete resting was provided.

Statistical Analysis

All the obtained data were analyzed on computer. The arithmetic averages (X), and standard variations (ss) of the groups were taken and no significant difference was detected between pre-test averages ($p=0$). However, significant differences were found between pre-test scores and post-test scores obtained, after 8-week trainings ($p<0.05$). In order to detect which group caused the significance difference between the groups, post-test averages were paired and analyzed with Paired Samples t-test. The significance level was taken as $p<0.05$.

Plyometric and Core Training Programs

30-45 minute program was implemented twice a week on the same days and time for 8 weeks in

addition to the yearly training program. Exercises were done after 15-20 minute general and specific warm-ups with time and repeat methods, while proper rests were given. Core and plyometric training programs presented in Tables 1, 2, 3, 4, 5 and 6 were implemented regularly by two trainers who also did their masters degrees in Mugla Sitki Kocman University, School of Physical Education and Sports Department of Coaching Education. Trainings were organized in accordance with wave and station methods.

Table 1: 1st and 2nd week plyometric training program

Plyometric exercises	*Reps*	*Sets*
Kangaroo hops	15	2
Depth jumps	15	2
Double leg forward hops	15	2
Single leg hops	15	2
Squad	15	2
Zigzag bounding	15	2
Total	90	12

Table 2: 3rd, 4th, 5th and 6th week plyometric training progra

Plyometric exercises	*Reps*	*Sets*
Jump over boxes	20	3
Plyometric bounding + Push-up	20	3
Double leg hops over barriers	20	3
Single leg hops	20	3
Squad	20	3
Zigzag bounding	20	3
Total	120	18

Table 3: 7th and 8th week plyometric training program

Plyometric exercises	*Reps*	*Sets*
Double leg forward hops	12	4
Plyometric bounding + Push-up	12	4
Double leg hops over barriers	12	4
Double leg forward hops	12	4
Squad	12	4
Zigzag bounding	12	4
Total	72	24

Table 4: 1st, 2nd and 3rd week core training program

Plyometric exercises	*Time (secs)*	*Reps*
Side plank	30	4
Sit-up	30	4
Plank	30	4
Side bridge	30	4
Alternate Plank	30	4
Plank+Push-up	30	4
Total	180	24

Table 5: 4th, 5th and 6th week core training program

Plyometric exercises	*Time (secs)*	*Reps*
Side plank	45	5
Sit-up	45	5
Plank	45	5
Side bridge	45	5
Alternate Plank	45	5
Plank+Push-up	45	5
Total	270	30

Table 6: 7th and 8th week core training program

Plyometric exercises	*Time (Secs)*	*Reps*
Side plank	35	3
Sit-up	35	3
Plank	35	3
Side bridge	35	3
Alternate plank	35	3
Plank+Push-up	35	3
Total	210	18

RESULTS

Comparison of pre-test measurements of the two groups before 8-week core and plyometric exercises presented no significant differences ($p>0.05$) (Table 7). It can be said that these groups are same.

According to paired t-test results, statistically significant ($p<0.05$) differences were found in back strength ($t=-2.93$, $p=0.009$), leg strength ($t=-4.23$, $p=0.001$), right hand grip strength ($t=-4.05$, $p=0.001$), left hand grip strength ($t=-5.07$, $p=0.000$), and vertical jump ($t=-7.7$, $p=0.000$). However, no statistically significant ($p<0.05$) difference was found in flexibility ($t=-1.37$, $p=0.19$) (Table 8).

In Table 9, paired t-test results (pre-test and post-test averages of 8-week core training) showed that statistically significant differences were found in back strength ($t=-2.56$, $p=0.020$), right hand grip ($t=-3.3$, $p=0.004$), and vertical jump parameters ($t=-5.74$, $p=0.000$) ($p<0.05$). There were no significant differences in leg strength, left hand grip, and flexibility parameters ($p>0.05$).

In Table 10, t- test analysis results for post-tests of 8-week plyometric and core training showed that there were statistically significant differences in back strength ($t=-2.37$, $p=0.030$), leg strength ($t=-2.14$, $p=0.047$), and vertical jumps ($t=-3.37$, $p=0.004$) ($p<0.05$). On the other hand, no statistically significant differences were detected in right hand grip strength, left hand grip strength and flexibility ($p>0.05$).

Table 7: Comparison of pre-test measurements of groups

Variables	*n*	*Plyometricpre-test (X,±sd)*	*Corepre-test (X,±sd)*	*t*	*p*
Back strength	30	112.44± 18.28	123.45 ± 30.31	-1.71	.11
Leg strength	30	99.63± 13.34	111.57 ± 23.98	-1.29	.21
Right hand grip	30	39.60± 5.46	41.63 ± 4.01	-1.14	.27
Left hand grip	30	38.66± 6.02	41.07 ± 6.50	-1.16	.26
Flexibility	30	29.38± 9.95	33.02 ± 8.17	-1.37	.19
Vertical jump	30	35.38± 6.64	37.44 ± 5.96	-5.57	.31

p<0.05

Table 8: t-test analysis results of pre-test and post-test averages of 8-week plyometric training

Variables	*n*	*Plyometricpre-test (X,±sd)*	*Corepre-test (X,±sd)*	*t*	*p*
Back strength	15	112.44 ± 18.28	114.76 ± 17.87	-2.93	.009*
Leg strength	15	99.63 ± 13.34	103.74 ± 13.59	-4.23	.001*
Right hand grip	15	39.60 ± 5.46	41.97 ± 5.10	-4.05	.001*
Left hand grip	15	38.66 ± 6.02	40.10 ± 5.84	-5.07	.000*
Flexibility	15	29.38 ± 9.95	30.11 ± 9.59	-1.37	.190
Vertical jump	15	35.38 ± 6.64	43.55 ± 4.84	-7.7	.000*

* p< .05

Table 9: t-test analysis results of pre-test and post-test averages of 8-week core training

Variables	*n*	*Plyometricpre-test (X, ±sd)*	*Corepre-test (X,±sd)*	*t*	*p*
Back strength	15	123.45± 30.31	136.56± 36.07	-2.56	.020*
Leg strength	15	111.57± 23.98	117.17± 19.67	-1.38	.34
Right hand grip	15	41.63± 4.01	43.69± 4.30	-3.3	.004*
Left hand grip	15	41.07± 6.50	42.58± 5.42	-2.01	.06
Flexibility	15	33.02± 8.17	47.44± 5.96	-0.5	.63
Vertical jump	15	37.44± 5.96	49.33± 5.34	-5.74	.000*

* P< .05

Table 10: t- test analysis results for post-tests of 8-week plyometric and core training

Variables	*n*	*Plyometricpre-test (X,±sd)*	*Corepre-test (X,±sd)*	*t*	*p*
Back strength	30	114.76± 17.87	136.56± 36.07	-2.37	.030*
Leg strength	30	103.74± 13.59	117.17± 19.67	-2.14	.047*
Right hand grip	30	41.97± 5.10	43.69± 4.30	-1.2	.25
Left hand grip	30	40.10± 5.84	42.58± 5.42	-1.6	.13
Flexibility	30	30.11± 9.59	47.44± 5.96	-1.46	.16
Vertical jump	30	43.55± 4.84	49.33± 5.34	-3.37	.004*

*P< .05

DISCUSSION

Statistically significant differences were observed in players' motoric capabilities (back strength, leg strength and vertical jump) measured after 8-week plyometric and core training (p<.05). Comparing the effects of two different strength trainings on motoric capabilities, it is observed that core training contributed more than plyometric training (p>0.05).

Review of the related literature revealed the following: Pienaa and Coetzee (2013) aimed to determine the effects of a microcycle (4 weeks) combined rugby conditioning plyometric com-

pared with a non-plyometric rugby conditioning program on selected physical and motor performance components and anthropometric measurements of university-level rugby players. Findings show that 3 weekly combined rugby conditioning plyometric programs in rugby players' training regimens to improve the players' speed, agility, and power. Ates and Atesoglu (2007) conducted a study on 16-18 age group soccer players in which they implemented a training twice a week for 10 weeks program in addition to their soccer trainings; and found significant differences in vertical jump parameters. In the present study we found that both strength training parameters contributed to vertical jump values; which comply with that study.

Many researchers have found in their studies conducted in various sports branches that core and plyometric trainings increased vertical jump values (Sannicandro et al. 2014; Houghton et al. 2013; Behrens et al. 2014; Potdevin et al. 2011; Al–Ahmad 1990; Gunay and Ozder 1994; Agaoglu et al. 2000). The findings of the present study comply with the findings of the researches in the literature.

Review of the related literature revealed that, core trainings have positive contributions to processes of preventing injuries and rehabilitation (Shi et al. 2012; Sumit and Sohan 2013). Houghton et al. (2013) aimed to determine whether intermittent shuttle running times and Achilles tendon properties were affected by 8 weeks of plyometric training or normal preseason. The results showed that plyometric training had possible benefits on intermittent shuttle running times and improved jump performance. Also, plyometric training increased tendon cross-sectional area, but further investigation is required to determine whether this translates to decreased injury risk.

Some researchers compared the eccentric and concentric strength production of upper and lower extremity muscles after 8-week plyometric training and found out that lower extremities gained strength while upper extremities didn't. They stated that the reason for this difference was that upper extremity muscle groups are smaller that lower extremity muscle groups, although both upper and lower extremities were loaded equally. They suggested that, lower extremity muscles can be loaded eight times more than upper extremity muscles (Wilson et al. 1993). It was observed that core trainings increased strength and endurance of muscle groups of central region (Afyon and Boyaci 2013; Michelle and Jonathan 2013; Qianyun et al. 2013). These findings also comply with the present research.

Afyon and Boyaci (2013) found in their research conducted on sedentary individuals that core-plyometric trainings increased flexibility values at a statistically significant level. In the present research conducted on soccer players, no increase was found in flexibility values. The reason for this is thought to be that soccer players didn't do the flexibility exercises properly before training, during training and also during cooling down after training.

The effect of plyometric training on soccer players' development was found to be statistically significant. However, when compared with core training results, the differences in back strength, leg strength and vertical jumps were statistically significant in favor of core training ($p < .05$).

CONCLUSION

In conclusion, when the effects of two different strength training on motoric capabilities are compared, it is that core training contributed more than plyometric training. Therefore, core training may contribute to processes of strength development, injury and rehabilitation.

RECOMMENDATIONS

It is suggested that, soccer trainers include core trainings in their training programs. Participants of this study were selected from one soccer team. In future studies, number of participants should be increased by adding soccer players of other teams.

LIMITATIONS

There were no professional soccer teams in city center of Mugla. Therefore the participants of our study are amateur soccer players and we had not inclusion criteria.

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