The effect of short-term training program on sprint speed and vertical jump (comparison study between university soccer players and elite soccer players)

Author: ***Diyar Muhammed Ali***

Garmian University

College of basic education

Department of physical education

MSc in sport and exercise science

Major: Nutrition and physiology

Keywords: vertical jump, sprint speed, soccer, impact of training program

Abstract

The aim of this research was to determine the impact of short-term training program on sprint speed and vertical jump between university soccer players and elite soccer players. In this study the participants were of male gender, with an age, height, and weight of 20±2 years, 177.1± 1.5 cm, and 72.6± 2.4 kg, respectively. The initial subjects' reactions in height and speed prior to the training were measured using t-tests. There were noticeable changes in both of the measured parameters. Furthermore, in the post-training results of the vertical jump were significantly better, with a value of 4 cm improvement, and the ($t = 1.443$, $p < 0.02$) which was (8.16%), as for the 20 m sprint in the second test the speed results were increased 0.37 seconds in comparison with the pre-training tests, the ($t = 1.088$, $p < 0.01$, or improvement in percentage by (10.95 %). Luebbers et al. (2003) found that the 4-week training program for the vertical jump high increase of 1.9 cm or 2.8%. Kotzamanidis et al. (2005), used speed training program for 35 of soccer players and found that the t-test revealed significant improvements in the CMJ from pre to post-test ($t = 4.201$, $p < 0.01$)

Introduction

One of the most popular sport in the world is soccer, different genders and age groups enjoy watching and participating the game (Reilly and Williams 2003). The sport soccer performance depends on several factors such as: technical/biomechanical, tactical, mental and physiological areas. Soccer is played widely across the globe and dedicated to player's needs of technical, tactical and physical skills to succeed (Chelly et al. 2010). Research indicates that physical performance in soccer depends on various characteristics (Bangsbo et al. 2000). One of the reasons that make soccer so popular worldwide is that players do not need to have a high level of technique, but should have a reasonable level within all areas (Reilly et al. 2000). However, there are trends towards more systematic training and selection influencing the anthropometric profiles of players who compete at the highest level. As with other activities, soccer is not a science, but science may help improve performance. At the highest level, efforts to improve soccer performance often focus on techniques and tactics at the expense of physical fitness (Stolen et al. 2005). Ekblom (1986), states that soccer is characterized as a high intensity, intermittent non-continuous exercise. Soccer players must have speed, strength, agility, power, and endurance as basic qualities before the individual skills can develop further (Raven et al. 1976). Strength, power, as well as acceleration, sprinting, and jumping are all important factors that can affect the performance of players (Hoff and Helgerud 2004). They have to adapt to the requirements of the game to compete at the highest standard. Therefore, the physical strength of top-class players may give an indication of the great demands of the game (Reilly 1997).

Newton et al. (1997) believe that speed strength, also known as power, is crucial for the performance of different sport actions involving changes in direction, accelerations, and jumps. Training to improve power traditionally uses different vertical jump (VJ) routines, whether or not they are associated with heavy strength training exercises (Adams et al. 1992, Baker 1996 and Weiss et al. 2000).The current report focuses on vertical jump (VJ) and 20-meter sprinter. Sprinting, and running with maximal effort. This is discernible from cruising by the arm and head movements (Deutsch et al. 2007). The report aims to determine the participants 's current level of fitness relative to vertical jump and 20-meter running by designing and performing a testing battery specific to the sport.

Method

Eighteen soccer players of Garmian University participated in the experiment. They attended 12 training sessions; which were carried out within 4 weeks, 3 training sessions per week. Two tests were conducted during each day of the program, the pre-tests were preformed prior to the start of the training and post-tests at the end of each training program. In the duration of the study the participants continued with their daily trainings and social soccer games, once or twice a week. Before the test procedure (initial measurement – re-evaluation), the participant followed the same preparation warm-up protocols. The duration of warm-up period was between 30 to 35 minutes. During the warm up period of the participants was observed and instructions were given to prepare them for the next practice (Rösch et al. 2000). Additionally, the body height and weight of the participants were measured in laboratory, see ***Table 1****, below.*

Table 1: Measured height and weight of the participants

Age	20±2 years
Height	177.1± 1.5 cm
Weight	72.6±2.4kg
Body composition (BMI)	23.19 kg/m^2

Experimental Design

The measured Data were collected in Jihan clinical laboratory in Kalar and Garmian University. The body weight and height of the participants were measured by Body composition. The vertical jump and 20-meter sprint speed tests were carried out using the timing gates and Jump Mat Standard.

Training program

The participants followed the training program. The training program had duration of four weeks and the participants attended 12 training sessions held throughout the 4 weeks according to Smirniotou 2011. The preparation procedure for the warm-up protocol in all parts of the training program with the same protocol was implemented during the testing sessions. The participants followed the training program 3 times a week. The daily schedule training for 20 meters sprint speed included 4 repetitions of maximum intensity 30m and 50m sprint such as (4 × 30 m and 4 × 50 m). The duration of recovery time was 4 and 6 minutes respectively between the 30m and 50m runs. During the last 30 meter sprint and the first 50 meter sprint 10 - minute recovery were applied. The speed of the sprint training was characterised by a maximum intensity of incentives repeats of 2 to 4 times per week (Smirniotou 2011).

In addition, sprinting speed training should not exceed 400 to 500 m in total (Mann and Hagy 1980).

Finally, the training program of this study consisted of 4 x 4 x 30 and 50 meters run at a frequency of three times a week (4 x 4 x 30 and 50= 150 + 200 = 320 meters). Thus, Blonc et al. (2007), state that the four minutes of recovery time are sufficient for the body to achieve full recovery.

The daily schedule training in appendix 1 for vertical jump included drills over 4 hurdles:

- *6 x 4 sets double-leg hurdle hops.*
- *4 x 4 alternated single- leg hurdle hops.*
- *4 x 4 single-leg hurdle hops and 4 x 4 40-cm drop jumps.*

Adams et al., (1992) purport that this training program for vertical exercise has been chosen because that strength training is the practice of safe and effective for the lower body muscle participants directly in power task investigated in this study. Traditional training with heavy load and low repetitions 4 sets - 6RM seems to increase the sprint speed, strength, and power (Adams et al. 1992, Weiss et al. 2000, Newton and Kraemer 1994).

Vertical jump test

Three of the countermovement jumps (CMJ) were counted and carried out in accordance with the method of the protocol, and the participants were trained to hand-held or arm swing for the duration of the jumps. Every jump was separated by a rest period of 20 seconds. The subjects were required to jump on the mat unit, the unit was connected to a computer, with every jump result shown in the computer. These tests were conducted in the Jihan clinical and Garmian University. The participants were told to jump to the highest possible level in every one of the 3 attempts were required. After take-off the loss of contact with the mat activated the system, which then recorded the flight time, and converted it to a height in cm as seen (Fig. 1). Moreover, there was a 20 second rest between each attempt (Tricoli et al. 2005).

Sprint Test

The completion time was recorded. A mat of contact has been established since the start of 20 m sprint and a light gate was marked. Once the participants stepped on the contact mat of the first sprint stride from a standing start, the key management service (KMS) program was initiated at the time of recording, started and stopped when the participants passed through the gates. Each sprint test started in a standing position from a line of 30 cm before the start line as seen in (Figure 2). They performed 3 trials and the best performance of the lowest time to complete was recorded (Kean et al. 2006). The participant performed a standard 10 minutes jog warm-up. The examiner chooses a

20 m to simulate the sprint distance a soccer player performs in a match situation (Deutsch et al. 1998, Fletcher and Jones 2004). The gates were set one meter high with one meter apart and thirty seconds from a pre-marked start point. The pre and post-test were carried out in the controlled indoor environment, which was a sport hull in Garmian University, to minimize source of error caused by outside factors (wind strength, direction and ambient temperature etc.). The participants used sport trainers throughout the test procedures (McFarlane 1984, Tabachnik 1992).

Data Analysis

Pre-test for the participants were compared with the estimated standard elite soccer players to show the required to improvements from the participants in term of vertical jump and sprint speed of 20 meters, as seen in ***Table 2****.*

Table 2: Analysis of performance results and comparison with elite normative values

Soccer players	Result	Elite normative value (mean ± SD)	Reference	improvement	Reason
Stature (cm)	177.1± 1.5	176.0 ± 1.9	Raven et al. (1976)	-	
Mass (kg)	72.6±2.4	74.4 ± 5.8	Faina et al. (1998)	-	
Body composition Body fat (%)	10.2±1.13	8.1±1.16	Raven et al. (1976)	-	
10-m sprint speed (Sec)	1.82	1.83	Little and Williams (2005)	-	Doesn't need to improve in10-m sprint as seen, the participants results are better than the elite normative
20-m sprint speed (Sec)	3.38	2.85	Tanner and Gore (2013)	✓	In 20-m sprint speed the participants' results drop significantly from the 10-m sprint speed result and elite normative results.
Vertical jump (cm)	49	64	Tanner and Gore (2013)	✓	15 cm differences between the elite normative and participants' results also need improvements
Agility zig zag test (Sec)	6. 04	5.60	Kutlu et al. (2012)	-	

Result

*The characteristic of the participants in age, stature, body mass, body composition, agility zigzag, and sprint speed (10 m) and (20 m) are given in the (**Table 1, Table 2**). The values in age, height and mass remained unchanged. The statistical analysis of the exercise test data was made by the participants, as seen in (**Table 3**).*

Table3: Pre and post-test for vertical jump and 20-meter sprint speed of participants

Subject	pre-test	post-test	t Stat	P-value	Difference (%)
Vertical jump (cm)	49	53	1.44342	0.029461	8.16%
20-m sprint speed (sec)	3.38	3.01	1.088518	0.013547	10.95 %

*The pre-test vertical jump was recorded at 49 cm, in **Table 3**; this value from pre to post-test ($t = 1.443$, $p < 0.02$) 53 cm and improved by 8.16%. The participants completed the 20-m sprint speed in 3.38 seconds during the pre-test, and during the post-test the subjects were able to complete this task at recorded time of 3.01 seconds, which was decreased by -0.37 seconds also the ($t = 1.088$, $p < 0.01$, or improvement in percentage by (10.95 %). The results showed that the training program had a significant impact and improvements as a percentage of maximal value on vertical jump and sprint speed during the 4 weeks, as seen in (**Table 3**). Before starting the training program, the participant took several tests on zigzag agility, vertical jump, and sprint speed, because testing those abilities are essential in a soccer player. After obtaining the test result of the participants, the values were compared with the elite normative values and it was clear that the participants needed to improve the vertical jump and sprint as seen in (**Table 2**), the result for the average vertical jump and sprint speed were (3.38 sec, 49 cm respectively). However, the elite normative value for vertical jump and sprint speed were (2.85 sec, 64 cm respectively). Moreover, the participant followed the training program for duration of 4 weeks to improve the lower value when the participants obtained it in pre-test as shown in (**Figure 1 and 2**).*

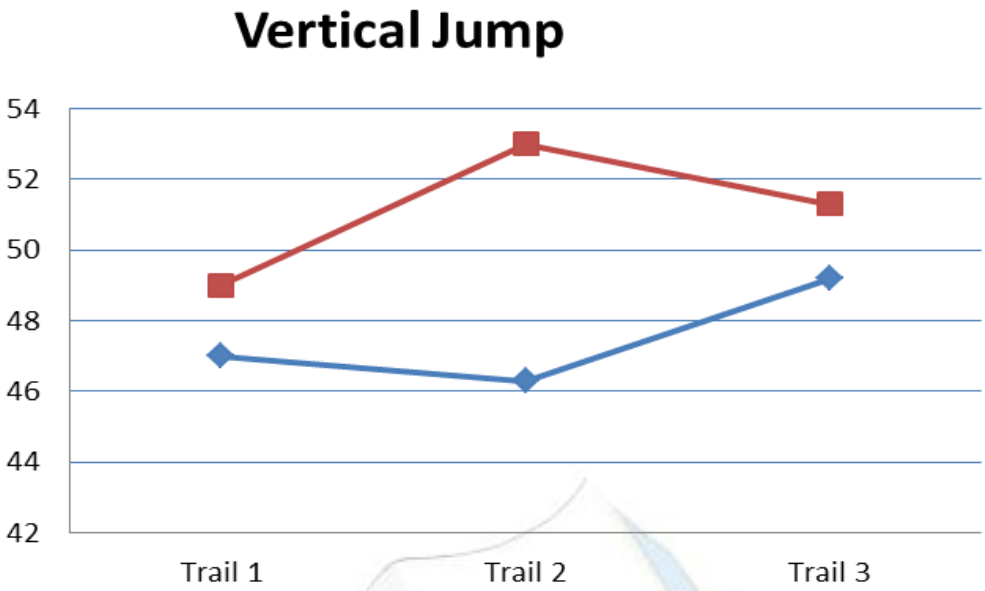

Figure 1: Shows the differences between pre and post-test for the vertical jump.
*Blue line= pre-test
*Red line= post-test

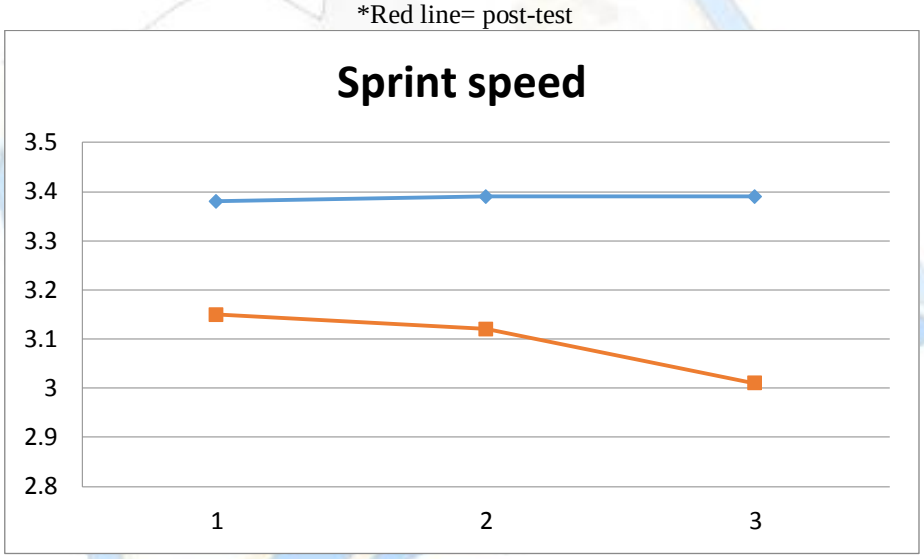

Figure 2: Shows the differences between time/sec **pre** and post-test for the 20m sprint speed.

*Blue line= pre-test
*Red line= post-test

Discussion

The study intervention included 4 weeks of vertical jumping and 20 m sprint speed training, this study was derived from an article by (Smirniotou 2011, Kean et al. 2006). The participants in training program completed the program 3 times per week with each session lasting approximately one hour. Training logs were kept and the examiners recorded the date of each of the training sessions and the completion of each exercise. Luebbers et al. (2003) found that the 4-week training program for the vertical jump high increase of 1.9 cm or 2.8%. Chelly et al. (2010) showed gains relative to controls in peak power output PP ($p < 0.01$)

countermovement jump (henceforth CMJ) (height p < 0.001. Velocity p < 0.001 average power p < 0.01). Kotzamanidis et al. (2005), collected the speed training program and high intensity strength on the jumping and running ability for 35 of soccer players and found that the t-test revealed significant improvements in the CMJ from pre to post-test (t = 4.201, p < 0.01). Fletcher and Jones (2004) also showed that the speed of 20 meters sprint at the phase of pre-and post-test differences in times of sprint and a significant increase (P ≤ 0.05) between the pre and post-test. The effects of resistance training program were different in vertical jump and sprint speed for 20 meter performance on a large scale. While earlier research tended to focus on whether resistance training affected sprint speed and vertical jump ability, more recent researches are intended to determine the type of resistance training that are the most effective in improving the sprint speed and vertical jump. Running velocity (RV) improvement is obtained when the element is increased without decreasing other factors, or when both factors are improved (Saraslanidis 2000, Mann and Hagy 1980). The best known training method for RV improvement is repetitive sprint training. The repetitive training method is believed to result in RV improvement during the maximum speed phase (Zafeiridis et al. 2005, Delecluse et al. 1995). Running velocity can be a key factor in many sports as it can determine the fastest athlete, who usually win a race from their opponents. Good running performance requires a fast reaction at start, as well as achievement and maintenance a high speed, and is divided into sub-phases: the acceleration phase, the success of the maximum speed, the maintenance phase and decelerating (Smirniotou 2011).

Recommendations

The current recommendations for improving sprint speed and vertical jump in soccer player based both on theory and evidence is to use warm-up period running for 8 minutes and stretching exercises for 12 minutes, sprint specific exercises for 10 minutes. Then 2 x 50m (>85% best performance). Finally, double-leg hurdle hops 6 x 4 RM.

The purpose of the program was to improve the sprint speed and recruitment of the muscles involved in the vertical jump. The goal of this training program was to improve performance. The participants took advantage of this program not only in improving the speed and vertical jump, but also their power and strength. It is suggested that the methods and specific exercises should be developed to improve sprint speed and

vertical jump performance. Therefore, this training program is highly recommended, as it has more than one factor to success in the sport. The training program period of 4 weeks improved muscle strength and speed. In fact, it is suggested that the combination of the basic physical training with sport specific movements can have an effective strategy to improve these skills in preseason. Supporting the results Kotzamanidis et al. (2005), it is found that the 4-week training program can improve vertical jump and sprint speed in the 0-20 m sprint speed as well. Additionally, significant improvement in the counter movement from pre to post-test were ($t = 4.201$, $p < 0.01$). Tricoli et al. (2005) found that the training program was increased after 4-week. Pre and post-testing consisted of a counter movement jump (CMJ) tests and 10-m and 30-m sprint speeds, and agility test; the program significantly increased the CMJ value ($p < 0.05$).

References

- *ADAMS, Kent, et al. (1992). The effect of six weeks of squat, plyometric and squat-plyometric training on power production. The journal of strength & conditioning research, **6** (1), 36-41.*
- *BAKER, Daniel (1996). Improving vertical jump performance through general,*
- *conditioning research, **10** (2), 131-136.*
- *BANGSBO, Jens, et al. (2000). Muscle oxygen kinetics at onset of intense dynamic exercise in humans. American journal of physiology-regulatory, integrative and comparative physiology, **279** (3), R899-R906.*
- *BLONC, S., et al. (2007). Effect of recovery duration on the force-velocity relationship. International journal of sports medicine, 19 (04), 272-276.*
- *BOBBERT, Maarten F. and VAN SOEST, Arthur J. (1994). Effects of muscle strengthening on vertical jump height: A simulation study. Medicine and science in sports and exercise, **26** , 1012-1012.*
- *CHELLY, Mohamed Souhaiel, et al. (2010). Effects of in-season short-term plyometric training program on leg power, jump-and sprint performance of soccer players. The journal of strength & conditioning research, **24** (10), 2670-2676.*
- *DELECLUSE, Christophe (1997). Influence of strength training on sprint running performance. Sports medicine, **24** (3), 147-156.*
- *DELECLUSE, Christophe, et al. (1995). Influence of high-resistance and high-velocity training on sprint performance. Medicine and science in sports and exercise, **27** , 1203-1203.*
- *DEUTSCH, , KEARNEY, and REHRER (2007). Time–motion analysis of professional rugby union players during match-play. Journal of sports sciences, **25** (4), 461-472.*
- *DEUTSCH, MU, et al. (1998). Heart rate, blood lactate and kinematic data of elite colts (under-19) rugby union players during competition. Journal of sports sciences, **16** (6), 561-570.*

- *DIALLO, O., et al. (2001). Effects of plyometric training followed by a reduced training programme on physical performance in prepubescent soccer players. Journal of sports medicine and physical fitness,* ***41*** *(3), 342-348.*
- *FLETCHER, Iain M. and JONES, Bethan (2004). The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players. The journal of strength & conditioning research,* ***18*** *(4), 885-888.*
- *HESPANHOL, Jefferson Eduardo, NETO, Silva and ARRUDA, Miguel de (2006). Reliability of the four series 15-second vertical jumping test. Revista brasileira de medicina do esporte,* ***12*** *(2), 95-98.*
- *KEAN, Crystal O., BEHM, David G. and YOUNG, Warren B. (2006). Research article fixed foot balance training increases rectus femoris activation during landing and jump height in recreationally active women. Journal of sports science and medicine,* ***5*** *, 138-148.*
- *KOTZAMANIDIS, Christos, et al. (2005). The effect of a combined high-intensity strength and speed training program on the running and jumping ability of soccer players. The journal of strength & conditioning research,* ***19*** *(2), 369-375.*
- *LUEBBERS, Paul E., et al. (2003). Effects of plyometric training and recovery on vertical jump performance and anaerobic power. The journal of strength & conditioning research,* ***17*** *(4), 704-709.*
- *MANN, Roger A. and HAGY, John (1980). Biomechanics of walking, running, and sprinting. The american journal of sports medicine,* ***8*** *(5), 345-350.*
- *MCFARLANE, Brent (1984). Developing maximum running speed. Strength & conditioning journal,* ***6*** *(5), 24-28.*
- *NEWTON, Robert U. and KRAEMER, William J. (1994). Developing explosive muscular power: Implications for a mixed methods training strategy. Strength & conditioning journal,* ***16*** *(5), 20-31.*
- *NEWTON, Robert U., et al. (1997). Influence of load and stretch shortening cycle on the kinematics, kinetics and muscle activation that occurs during explosive upper-body movements. European journal of applied physiology and occupational physiology,* ***75*** *(4), 333-342.*
- *ORENDURFF, Michael S., et al. (2010). Intensity and duration of intermittent exercise and recovery during a soccer match. The journal of strength & conditioning research,* ***24*** *(10), 2683-2692.*
- *RAVEN, PB, et al. (1976). A physiological evaluation of professional soccer players. British journal of sports medicine,* ***10*** *(4), 209-216.*
- *REILLY et al. (1990). Physiology of sports. London, UK, p. 71-101.*
- *REILLY, T. (1997). Energetics of high-intensity exercise (soccer) with particular reference to fatigue. Journal of sports sciences,* ***15*** *(3), 257-263.*
- *REILLY, Thomas and WILLIAMS, A. Mark (2003). Science and soccer. Psychology Press.*
- *REILLY, Thomas, BANGSBO, Jens and FRANKS, A. (2000). Anthropometric and physiological predispositions for elite soccer. Journal of sports sciences,* ***18*** *(9), 669-683.*
- *RONNESTAD, Bent R., et al. (2008). Short-term effects of strength and plyometric training on sprint and jump performance in professional soccer players. The journal of strength & conditioning research,* ***22*** *(3), 773-780.*

- *RÖSCH, Dieter, et al. (2000). Assessment and evaluation of football performance. The american journal of sports medicine, **28** (suppl 5), S-29-S-39.*
- *SARASLANIDIS, Ploutarchos (2000). Training for the improvement of maximum speed: Flat running or resistance training. New studies in athletics, **15** (3/4), 45-51.*
- *SMIRNIOTOU, ATHANASIA (2011). Klimentini martinopoulou, polyxeni argeitaki, georgios paradisis, christos katsikas. Biology of exercise, **7** (1), 8-23.*
- *TABACHNIK, Ben (1992). Strength training modalities: The speed chute. Strength & conditioning journal, **14** (4), 75-81.*
- *TRICOLI, Valmor, et al. (2005). Short-term effects on lower-body functional power development: Weightlifting vs. vertical jump training programs. The journal of strength & conditioning research, **19** (2), 433-437.*
- *WEISS, LAWRENCE W., et al. (2000). Comparative effects of deep versus shallow squat and leg-press training on vertical jumping ability and related factors. The journal of strength & conditioning research, **14** (3), 241-247.*
- *WISLOEFF, HELGERUD, and HOFF (1998). Strength and endurance of elite soccer players. Medicine and science in sports and exercise, **30**, 462-467.*
- *ZAFEIRIDIS, A., et al. (2005). The effects of resisted sled-pulling sprint training on acceleration and maximum speed performance. Journal of sports medicine and physical fitness, **45** (3), 284-290.*

Appendix 1

Four weeks training program for vertical jump and 20-meter sprint.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	*The warm-up period* *- Running for 8 minutes* *- Stretching exercises for 12 minutes* *- Sprint specific exercises for 10 minutes.* *- 2 x 50m (>85% best performance). 5-minute recovery between reps* *- Double-leg hurdle hops 6 x 4 RM*	A recovery day	*The warm-up period* *-Running for 8 - 10 minutes* *-Stretching exercises for 10 - 15 minutes* *-Sprint specific exercises for 10 minutes.* *- Half-squat 4 x 6 RM* *- 4 repetitions of 50-60m runs of increasing intensity*	A recovery day	*The warm-up period* *- Running for 8 minutes* *- Stretching exercises for 12 minutes* *- Sprint specific exercises for 10 minutes.* *- 2 x 50m (>85% best performance). 5-minute recovery between reps* *- Double-leg hurdle hops 6 x 4 RM*	A recovery day	A recovery day
2	*The warm-up* *- 10 minute running* *- 15mint stretching exercise* *- 10 mint sprint specific exercise* *- Alternated single-leg hurdle hops 4 x 4 RM.* *- 4 x 30m with 100% effort. Interval:4-6 minutes between reps*	A recovery day	*- Warm up training for duration 30-35 minutes* *- 3 repetitions of 50-60m run of increasing intensity.* *- Single-leg hurdle hops 4 x 4 RM.*	A recovery day	*The warm-up* *- 10 minute running* *- 15mint stretching exercise* *- 10 minute sprint specific exercise* *- 4 x 30m with 100% effort.* *- Interval:4-6 minutes between reps* *- Alternated single-leg hurdle hops 4 x 4 RM.*	A recovery day	A recovery day
3	*Warm up training for duration 30-35 minutes* *- 3 repetitions of 50-60m runs of increasing intensity.* *- 4 x 50m with 75% effort.* *- 4-6 minutes recovery between reps* *- Single-leg hurdle hops 4 x 4 RM.*	A recovery day	*The warm up lasted 30-35min. And included (10 minutes of jogging 10 minutes of stretching 10 minutes of special exercises, such as skipping).* *- 3 repetitions of 60m run of increasing intensity.* *- Alternated single-leg hurdle hops 4 x 4 RM.*	A recovery day	*Warm up training for duration 30-35 minutes* *- 3 repetitions of 50-60m runs of increasing intensity.* *- 4 x 50m with 75% effort.* *- 4-6 minutes recovery between reps* *- Single-leg hurdle hops 4 x 4 RM.*	A recovery day	A recovery day
4	*30 minute warm-up 4 x 50m with 100% effort. Interval: 8-10 minutes between reps* *- 40-cm drop jump 4 x 4 RM.*	A recovery day	*The warm-up period* *-Running for 8 - 10 minutes* *-Stretching exercises for 10 - 15 minutes -sprint specific exercises for 10 minutes.* *- 4 repetitions of 50m runs of increasing intensity* *-Double-leg hurdle hops 6 x 4 RM*	A recovery day	*30 minute warm-up 4 x 50m with 100% effort. Interval: 8-10 minutes between reps* *- 40-cm drop jump 4 x 4 RM.*	A recovery day	A recovery day

(Smirniotou 2011)