Effects of core strength training on power, speed and agility on soccer players in Digotsion Town; Northwestern Ethiopia

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Abstract - **The objective of this study was to examine the effects of core strength training on power, speed and agility on male U-17 soccer players of Digotsion Town, Northwestern Ethiopia. 20 male soccer players were purposively selected and voluntarily participated in this study. Subjects were divided randomly into two groups, experimental group: n=10 (age=15.9 years, body mass = 49.kg, height = 1.65 meter) and 10 subjects in control group (age = 15.9 years, body mass = 48.7kg, and height= 1.66meter. This research was an experimental (pre-test, post-test) design. Before the core strength training, pre-test results of the Experimental and Control Group of power tests (Vertical Jump Test and Standing Long Jump Test), speed tests (20m dash and 30m dash), and agility tests (Illinois agility test and T-test) were recorded. The subjects in the experimental group also took 40-minute core strength training twice a week and then continued the normal training program with the control group in other training days. After eight weeks, post-test measurements on the same parameters were taken. To analyse the parameters; means, standard deviations, and paired samples test were computed. The difference between the tests were analysed statistically, with paired sample "t" test at P<0.05. Consequently, it was observed that core strength training had a significant improvement of power, in vertical jump test and standing long jump test results were increased by a mean difference 1.60 cm and 2.60 cm respectively. The Speed tests in 20m dash and 30m dash results were decreased by a mean difference .056 second and .06 second, respectively. And agility tests in Illinois agility test and T-test were decreased by a mean difference .149 second and .349 second, respectively. And studies should be conducted in the same area on different samples in terms of age and gender.**

Index Terms - **power, agility, core strength, soccer players, speed.**

INTRODUCTION

Soccer is the most popular sport in the world. From the Andes to Greenland, people just cannot seem to resist kicking a leather ball around or watching others doing the same. The figures are staggering approximately 250 million people play the game regularly. In fact, if soccer players made up a nation, it would be the fourth most populous on the planet. You could almost say that soccer is a universal language (Goldbatt and David, 2011). Durandt, (2009) Stated that soccer players require a moderate to high levels of aerobic and anaerobic power, good agility, speed, and a variety of technical and tactical skills to bolster the likelihood of their success in the sport and to meet the physical demands of play as well as training components. And now a day coaches give variety of aerobics, strength and power trainings which involve large muscle group specially lower and upper extremities so as to meet the physical demands of soccer players.

According to Niessen, (2014) Football is a sport of intermittent nature that requires multiple and constant changes of direction running intensity, accelerations, and types of movements (running forwards, backwards, lateral movements, jumps, tackle, etc.). Afyon, (2014) stated soccer as a team sport of intense tackle so strong central body area decrease injury, improves explosive power, improve higher rate of anaerobic energy and technical movements with and without the ball.

Statement of the Study

According to Shinkle et al, (2012) definition, the core is considered a box with the abdominals and gluteal in back the diaphragms the roof, oblique's, as the side and the pelvic girdle and hip girdle musculature serving as the bottom. Core muscles are important for a soccer player as they serve a base for endurance, posture, strength, power, coordination, and reducing

likelihood of injury. Whether it's for fighting off an opposing player, or making that powerful kick to score, your core muscle plays an important role (Kisner, et al., 2007). All powerful movements originate from the center of the body out, and never from the limbs alone. Before any powerful, rapid muscle contractions can occur in the limbs, the spine must be solid and stable and the more stable the core, the most powerful the extremities can contract. Training the muscles of the core also corrects postural imbalances that can lead to injuries. The biggest benefit of core training is to develop functional fitness that is essential to both daily living and regular activities. Core strengthening exercises are most effective when the torso works as a solid unit and both front and back muscles contract at the same time, multi joint movements are performed and stabilization of the spine is monitored (Akuthota et al., 2008). (Afyon, 2014) added that strengthening core muscle is not only necessary for sportive performance but also provide a correct posture. And will allow a transfer of force from the lower body to the upper body with the minimal dissipation of energy in the torso. And if power is created but not transferred or no strong core muscle, performance may be affected negatively. And the purpose of this study was to see whether increasing core strength training would have an effect on power, speed and agility on male U-17 soccer players of Digotsion Town, Northwestern Ethiopia.

MATERIALS AND METHODS

Study Area and Period

This research was conducted at Digo Tsion town, capital of Bibugn woreda in East Gojjam Zone, Amhara region, Northwestern Ethiopia. And the period of the study was for eight consecutive weeks starting from March to May 2019. Debre Markos is the center of East Gojjam Zone, which is 299 Km distance away from the capital city of Ethiopia. Part of the Misraq Gojjam Zone, Bibugn is bordered on the south by Sinan, on the west by the Mirab Gojjam Zone degadamot woreda, on the northwest by Goncha, and on the east by Hulet Eju Enese. Towns in Bibugn include Digo Tsion, Weyin Wuha and Wabirr. Digo tsion(ድጎፅዮን) is the center of Bibugn wereda. Digotson which is located at latitude of 110 00' 0.00'' North and longitude of 370 34' 59.99'' East. It located about 81km far from the capital city of east Gojjam zone,

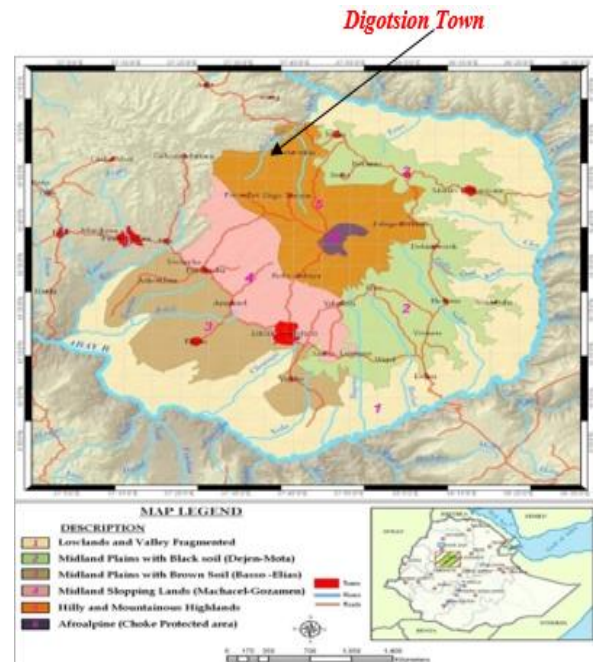Debre Markos. And it far distance about 741km from Jimma Town.

Figure 1; Map of the Study Site (Source: www.ethiomapingagency.com)

Study Design

The aim of the study was to evaluate the effects of core strength training on power, speed, and agility in U-17 soccer players. The basic design of this study was an experimental (pre-test, post-test) design specified an experimental and a control group. 20 soccer players with age of 15-16 years were selected from Digotsion District soccer project. Each subject was assigned to one of two groups either an experimental or a control group. Pre-test of power tests (vertical jump test and standing long jump test), speed tests (20m and 30m dash), and agility tests (Illinois agility test and T-test) were administered for the subjects. The subjects in the experimental group also took 40-minute core strength training for two days (Tuesday and Thursday) per week for eight consecutive weeks. The core strength training consisted of different kind of core strength exercises such as side bend, reverse plank with leg raises, bicycle kicks, modified sit-ups, russian twist, leg and hip raiser, alternative crunch, oblique, single plank, superman, reverse crunches, hip raiser, bird-dog, body saw, flutter kick, bicycle crunches, push up to side plank, single leg stabilizers, cooling down and stretching activities. And also, the experimental group continued the normal training program with the

control group in other training days. After eight weeks, post-test measurements on the same parameters were taken.

Subjects

20 subjects were voluntarily participated in the study from Digotsion Town soccer project team. The research design used in this study was purposive sampling. And among of 20 participants the researcher randomly selected the control group; n=10 and the experimental group, n=10 which a treatment was applied.

Data collection Instruments

Before a medical checkup, while they join in to the team, the researcher prepared a questionnaire for the identification of their current health status and translated in to Amharic('አማርኛ') language for ease of understanding and get confirmation to involve actively in this study. By physical examination with the help of two Medical Doctors and two health officers' anthropometric measurements of the players were recorded. And in the field tests with the help of eight test assistant and one coach, fitness tests were implemented. These were, two power tests (Standing Long Jump Test and vertical jump test), two speed tests (20m Dash and 30m dash sprint tests), and two agility tests (Illinois Agility Test and T-Test).

Vertical Jump Test (Vertical Leap)

This procedure describes the method used for directly measuring the vertical jump height jumped. There are also timing systems that measure the time of the jump and from that calculate the vertical jump height. Equipment required: measuring tape or marked wall, chalk for marking wall (or Vertec or jump mat). The athlete stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. The jumping technique can or cannot use a countermovement. Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded. The jump height is usually recorded as a distance score.

Procedures and analysis

Figure 2: picture of Vertical jump test

Table 1; Vertical Jump Test Protocols (Centimeter); for 16- to 19-year-olds.

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>65cm	50-65cm	40-49cm	30-39cm	<30cm
Female	>58cm	47-58cm	36-46cm	26-35cm	<26cm

Reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996

Standing Long Jump Test (Broad Jump)

The Standing long jump, also called the Broad Jump, is a common and easy to administer test of explosive leg power. The purpose is to measure the explosive power of the legs. -Equipment required: tape measure to measure distance jumped, non-slip floor for take-off, and soft-landing area preferred. The take offline should be clearly marked. The athlete stands behind a line marked on the ground with feet slightly apart. A two-foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed. The measurement is taken from take-offline to the nearest point of contact on the landing (back of the heels).

Record the longest distance jumped, the best of three attempts.

Procedure and analysis

Figure 3; picture of Standing Long Jump Test (Broad Jump)

Table 2; Standing long jump test protocols (Centimeter): for 15- to 16-year-old athletes.

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	>201cm	200-186cm	185-176cm	175-165cm	<165cm
Female	>166cm	165-156cm	155-146cm	145-135cm	<135cm

Reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996

20 Meter Dash sprint test
The aim of this test is to determine acceleration, and also a reliable indicator of speed, agility and quickness. Equipment required: measuring tape or marked track, stopwatch or timing gates, cone markers, flat and clear surface of at least 40 meters. The test involves running a single maximum sprint over 20 meters, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary position, with one foot in front of the other. The front foot must be on or behind the starting line. This starting position should be held for 2 seconds prior to starting, and no rocking movements are allowed. The tester should provide hints to maximizing speed (such as keeping low, driving hard with the arms and legs) and encouraged to continue running hard past the finish line. Two trials are allowed, and the best time is recorded to the nearest 2 decimal places. The timing starts from the first movement (if using a stopwatch) or when the timing system is triggered and finishes when the chest crosses the finish line and/or the finishing timing gate is triggered.

30 Meter Dash sprint test
The aim of this test is to determine acceleration and speed. Equipment required: measuring tape or marked track, stopwatch or timing gates, cone markers, flat and clear surface of at least 50 meters. Procedure: The test involves running a single maximum sprint over 30 meters, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary position, with one foot in front of the other. The front foot must be on or behind the starting line. This starting position should be held for 2 seconds prior to starting, and no rocking movements are allowed. The tester should provide hints for maximizing speed (such as keeping low, driving hard with the arms and legs) and encouraged to continue running hard through the finish line. Two trials are allowed, and the best time is recorded to the nearest 2 decimal places. The timing starts from the first movement (if using a stopwatch) or when the timing system is triggered and finishes when the chest crosses the finish line and/or the finishing timing gate is triggered.

Table 3; 30m dash test protocols (Seconds); for 16- to 19-year-olds.

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	<4.0	4.2-4.0	4.4-4.3	4.6-4.5	>4.6
Female	<4.5	4.6-4.5	4.8-4.7	5.0-4.9	>5.0

Reference: Davis B. et al; Physical Education and the Study of Sport; 2000

Illinois Agility Test

The Illinois Agility Test is a commonly used test of agility in sports, and as such there are many norms available. The purpose of these is to test running agility of soccer trainees. And the length of the course is 10 meters and the width (distance between the start and finish points) is 5 meters. Four cones are used to mark the start, finish and the two turning points. Another four cones are placed down the center an equal distance apart. Each cone in the center is spaced 3.3 meters apart. Subjects should lie on their front (head to the start line) and hands by their shoulders. On the 'Go' command the stopwatch is started, and the athlete gets up as quickly as possible and runs around the course in the direction indicated, without knocking the cones over, to the finish line, at which the timing is stopped.
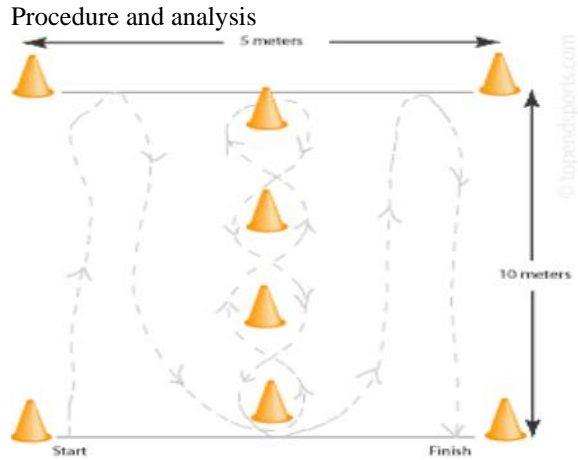
Procedure and analysis

Figure 4: Diagram of Illinois Agility Test

Table 4; Illinois agility test protocols (Seconds); for 16 to 19 years old athletes

Gender	Excellent	Above Average	Average	Below Average	Poor
Male	< 15.2	16.1-15.2	18.1-16.2	18.3-18.2	> 18.3
Female	< 17.0	17.9-17.0	21.7-18.0	23.0-21.8	> 23.0

Reference: Davis B. et al; Physical Education and the Study of Sport; 2000

T-Test

The purpose of this test is to test agility of athletes, and includes forward, lateral, and backward running. The measuring tape, marking cones, stopwatch, timing gates (optional) was used to arrange the test It is conducted by Set out four cones (5 yards = 4.57 m, 10 yards = 9.14 m). The subject starts at cone A. On the command of the timer, the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touch its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. They then shuffle back to cone B touch with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A. The trial did not count. The best time of three successful trials to the nearest 0.1 seconds was recorded as his score.
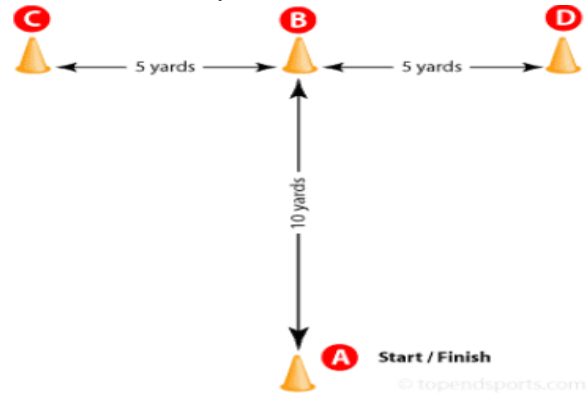
Procedure and analysis

Figure 5; Diagram of Agility T-Test

Table 5; T-Test protocols (Seconds)

Gender	Excellent	Good	Average	Poor
Male	< 9.5	9.5 to 10.5	10.5 to 11.5	> 11.5
Female	< 10.5	10.5 to 11.5	11.5 to 12.5	> 12.5

Data Collection Procedures

All athletes should get medical clearance before being allowed to involve in core trainings and field fitness assessment tests. After obtaining an informed consent with medical checkup and completed a questionnaire regarded their current health status, all 20 male U- 17 soccer trainees' were participated in the study. Each subject was assigned to one of two groups. Random assignment was used for participants to the two groups, by writing and giving a code for experimental group EG1- EG10, and for control group CG1-CG10, and then a player took his chance and registered parallel to his name. The independent variable was administered to experimental group and not to the

control group, and both groups were measured on the same dependent variable. Prior to data collection, field marking was done. Players need to be properly warmed up prior to conducting any test in order to avoid injuries and to improve the reliability of the tests results. Familiarity of the tests were practiced for two days and also again core strength exercises familiarity was made on the experimental group for two days, but for familiarity sessions no record of data was applied. When subjects were ready for the test, pre-test results of vertical jump test and standing long jump test, 20m and 30m dash, Illinois agility test and T-Test tests were recorded by the researcher with the help of professional assistants. All test assistants should be adequately trained prior to testing, to ensure correct administration of the tests, and reduce error between testers. The subjects in the experimental group also took 40-minute core strength training twice a week and then continued the normal training program with the control group in other training days. After eight weeks, post-test measurements on the same parameters were taken and results of the two groups were recorded. Each test was hold at the field of Digotsion Stadium near to Alemayehu Bezabih Elementary School which was the players' training venue.

The order in which the fitness tests performed can affect performance in subsequent tests. Blood pressure and resting heart rate tested first when the person was fully rested. Height was recorded with a stadiometer to the nearest .5 cm. Weight was recorded to the nearest .10 kg on a balance scale. Power tests were performed first, followed by speed and agility. The first session included vertical jump test and standing long jump test. The second session of assessments included the 20m dash and 30m dash sprint tests. The third session included the Illinois agility test and T-test. The test order was the same for all athletes.

Methods of Data Analysis

The data collected through fitness tests of power tests (vertical jump test and standing long jump test), speed tests (20m and 30m dash test) and agility tests (Illinois agility test and T-test) were presented as a group mean value and standard deviations. And the effects of core strength training on variables were analyzed in separate two pre coded groups; experiment group and control group twice, pre and posttests. And the difference between each test result was analyzed statically with descriptive statistics and paired samples "t"-test through SPSS software version 20. The significance level was set at $P < 0.05$.

RESULTS AND DISCUSSION

This part discussed the presentation, analysis and interpretation of the data collected on the field tests from the subjects. The purpose of this study was to investigate the effects core strength training on power, speed, and agility of Digotsion town male U-17 soccer trainees. The anthropometric, field experiment results and findings obtained after eight-week core strength training are presented below. And the abbreviations used in this research were as follows: Experimental Group (EG), Control Group (CG), Vertical Jump Test (VJT), Standing Long Jump Test (SLJT), 20-meter dash for speed test 1 (ST1), 30 meter dash for speed test 2 (ST2), and Illinois Agility Test (IAT) and T-test (TT).

Table 1. Anthropometric characteristics of the Subjects

Group	N	Age(years)	Body mass(Kg)	Height (m)
		X± SD	X± SD	X± SD
Experimental	10	15.9± .316	49.6±4.3957	1.65±.03529
Control Group	10	15.9±.316	48.7±4.7741	1.66±.06237
Total	20			

According to Table 1; Average age of the subjects; EG= 15.9 yrs; CG= 15.9 yrs.
Average body mass of the subjects; EG= 49.6 Kg; CG= 48.7 kg and
Height average of the subjects; EG=1.65m; CG= 1.66m.

Table 2; Mean and Standard Deviation of Pre-test and Post-test results of Vertical Jump Test and Standing Long Jump Test of the Subjects

Subjects	N	Pre-Test (cm) (X ,± SD)	Post-Test (cm) (X, ± SD)	ΔX (MD)	P value
VJT result of EG	10	37.20 ± 5.903	38.80±7.193	-1.600	.022
VJT result of CG	10	40.20 ± 5.391	40.20±5.574	.000	1.000

SLJT result of EG	10	210.50± 11.881	213.10±12.574	-2.600	.010
SLJT result of CG	10	207.20±14.551	206.20±15.433	1.000	.107

As Table 2: shows that Pre-test and post- test VJT mean of EG was 37.20 and 38.80 respectively. And the CG; PT and PoT result of VJT mean was 40.20 and 40.20 respectively. So these data indicated that there is a significant difference and gradual improvement between Pre-test and post-test results on both groups. In which in case of the EG, VJT test result was significantly increased by a PoT - PT mean difference of 1.600 cm at P=.022, after eight week of core strength training. And in case of the CG, VJT result was no significant change at mean difference of .000 cm at P=1.000. But in case of SLJT, a significant difference and gradual improvements was obtained only at the EG in which Pre-test and post-test result was 210.50 cm and 213.10 cm respectively. In which the SLJT result of this group was increased by a PoT - PT mean difference of 2.600cm at P= .010. But based on the pre given significance value in which the mean difference of pre and post SLJT result of the CG was 1.000 cm at P >.05.

Table 3; Mean and Standard Deviation of Pre-test and Post-test results of 20m dash (ST1) and 30m dash (ST2) tests of the Subjects

Subjects	N	Pre-Test (second) (X ,± SD)	Post-Test(second) (X, ± SD)	ΔX (MD)	P value
ST2 of EG	10	3.3010±.17489	3.2450±.16622	.05600	.011
ST2 of CG	10	3.2880±.19921	3.3020 ±.18677	-.01400	.122
ST2 of EG	10	4.8940±.21706	4.8340±.22177	.06000	.002
ST2 of CG	10	4.8100±.41382	4.8170±.40172	-.00700	.523

As Table 3: shows that Pre-test and post-test result of Speed test 1 (20m dash test) mean of EG was 3.3010 and 3.2450 respectively. And the CG; Pre-test and Post-test mean was 3.2880 and 3.3020 respectively. And also, pre-test and post-test ST2 results of the EG was 4.8940 and 4.8340 respectively. And also, the CG was 4.8100 and 4.8170 respectively. Therefore, these data indicated that there is a significant difference and gradual improvement between PoT - PT results of both

the EG and CG. In which incase of the EG, duration of 20m dash speed test (ST1) was significantly less by a PoT - PT mean difference of .05600 second at P=.011 and duration of 30m dash speed test (ST2) was significantly decreased by a mean difference of .06000 second at P= .002 after eight week of core strength training. And also in case of the CG, in which duration of 20m dash speed test (ST1) was significantly increased by a mean difference of .01400 at second P=.122 and duration of 30m dash speed test (ST2) was significantly increased by a mean difference of .00700 second at P=.523.

Table 4; Mean and Standard Deviation of Pre-test and Post-test results of Illinois Agility Test and T-test of the Subjects

Subjects	N	Pre-Test (second) (X ,± SD)	Post-Test(second) (X, ± SD)	ΔX (MD)	P value
IAT result of EG	10	17.0670±.41323	16.9180±.43667	.14900	.001
IAT result of CG	10	17.3650±.52741	17.3410±.48706	.02400	.421
T-Test result of EG	10	11.5840±.82874	11.2350±.82729	.34900	.007
T-Test result of CG	10	11.5850±1.09929	11.6630±1.14985	-.07800	.242

As Table 4: shows that Pre-test and post- test IAT mean of EG was 17.0670 and 16.9180 respectively. And the CG; PT and PoT result of IAT mean was 17.3650 and 17.3410 respectively. And also PT and PoT t-test results of the EG was 11.5840 and 11.2350 respectively. A PT and PoT t-test result of the CG was 11.5850 and 11.6630 respectively. So these data indicated that there was a significant difference and gradual improvement between PT and PoT test results on both groups. In which incase of the EG, duration of Illinois agility test was significantly less by a mean difference of .14900 at P= .001 and duration of T-test was significantly decreased by a PoT- PT mean difference of .34900 at P=.007 after eight week core strength training. And also in case of the CG, in which duration of Illinois agility test was significantly less by a mean difference of .02400 at P=.421 and duration of T-test was significantly increased by a mean difference of .07800 at P=.242.

CONCLUSIONS

In light of the results within the limitations of the present study, and the framework of statistical treatments used, the following conclusions are enumerated:

- The results of the study showed that eight week of core strength training has relative positive effect on power of U-17 soccer players as measured by vertical jump test and standing long jump test.
- The output of the study showed that eight week of core strength training has a significant improvement on agility of U-17 soccer trainees measured by Illinois agility test and T-test.
- The finding of this study yields a significant benefit on improvement of soccer players' speed measured by 20 metre dash and 30 metre dash tests.
- Core strength training has a significant effect on the improvement of power, speed and agility in U-17 soccer players.

RECOMMENDATIONS

Based on the findings of this study, the following points are recommended to investigate more on the effects of core strength training on power, speed and agility in U-17 soccer players.

- Sport Science professionals shall aware and prepare trainings for soccer trainers about progressive assessment and evaluation of training sessions.
- Using sufficient training contents and durations are recommendation as possible to strength the players' core for improving their power, speed and agility performances.
- Further research in the area should be conducted on other specific fitness components through increasing subjects and classifying by their positioning of play.
- And further studies should be conducted in the same area on different samples in terms of age and gender.

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