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The Effect of Concurrent Training on Physical Fitness of U-17 Male Football Project in Dilla Town

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ABSTRACT

The main objective of this study was to investigate the effect of concurrent training on physical fitness of U-17 male football players in Dilla Town. The researcher was used census sampling technique to select the sample of the study from Dilla U-17 male football project players. The age of the participants was range between 15 and 17 years old. The selected subjects were assigned in two groups of 12 experimental and 12 control groups randomly. The experimental groups were under go concurrent training program for the first 3 consecutive weeks (30minute and 3 days per week), for the second 3 consecutive weeks (40 minute and 4 days per week), and for the last 2 consecutive weeks 50 minute and 5 days per week for eight weeks, in addition to the training given by their coach. A pre and posttest were conducted on selected variables such as 30 m acceleration test, vertical jump test and Illinois agility test. The data was collected from pretest and posttest results and analyzed by descriptive statistics (mean and standard deviation) and inferential statistics (paired t-test and independent t-test) by using (SPSS) version 20. The results of the study showed that eight week programmed concurrent training was effective on selected subjects. In general, the researcher concludes that gradually increasing both intensity and duration of concurrent training within eight weeks intervention, statistically significance improvements and changes were observed in the players speed, power and agility.

Keywords: concurrent training, speed, power and agility.

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1. INTRODUCTION

Concurrent Training (CT) is the combination of strength and aerobic training in periodized program to maximize all aspects of physical performance or it used to describe both cardio and weights in training regime and achieving multiple training goals at the same time (Muluye Abeje, 2020). Concurrent training (CT), or exercising strength and endurance at the same time, was first documented by Robert C. Hickson in 1980 (Nader, 2006). As far as sports are concerned, endurance is the capacity to sustain or replicate a specific force or power output. According to Bazyler et al. (2015), strength is a skill that has a magnitude ranging from 0 to 100%. Sports like sprint running, rugby, football, swimming, and decathlon combine these divergent forms of exercise, training sessions together have been shown to be just as helpful as drug interactions.

Concurrent programming has drawn a lot of interest as a training method throughout the last 20 years (Arazi et al., 2011). There are still disagreements among coaches, though, over the value of strength training for endurance athletes. Resistance and endurance training have traditionally been thought of as training approaches with different adaptations that are at opposite ends of a continuum (Arazi et al., 2011). Concurrent exercise has been shown to improve and sustain fitness levels in earlier research (Kraemer & Ratamess, 2003). There is now considerable evidence concurrent training can compromise the development of muscle mass, strength and indices of power or rate of force development compared with undertaking alone (Wilson et al., 2012). Concurrent training is also essential for Athletes requiring elements of maximal strength,

power and hypertrophy in combination with high aerobic capacity (Aspe et al., 2022).

Concurrent training is the development of endurance and strength training at the same time or training session. Endurance and resistance training (RT) represent divergent exercise modes, with each distinct responses within the muscle milieu that act to minimize cellular stress during subsequent exercise bouts (Hawley, 2009). Train both muscle strength and cardiorespiratory fitness within a training cycle in a certain way to speed up performance. Team sports like soccer, for example, require both endurance and strength training. Concurrent training could potentiate the individual personal property produced by endurance training and strength training and increase athletic performance.

When strength and endurance training are combined well, recovery time can be increased and the amount of time spent on strength (resistance exercise) and aerobic exercise can be decreased (Rønnestad & Mujika, 2014). Because they are essential components of physical capability and primary regulators of significant football-specific activities, concurrent strength and endurance training is a significant co-determinant of football performance (Hoff & Helgerud, 2004). Strength training (resistance) training (ST) is a type of exercise that causes your muscles to contract against an outside resistance. Over the past 20 years, strength (resistance) training (ST) has gained appeal as an exercise modality because it can ameliorate athletic performance by enhancing muscular strength, power, and speed, hypertrophy, original muscle endurance, and motor skills, coordination, balance, and performance (Kraemer et al., 2002).

A football player's strength during jumping, pushing during a sprint, stopping and pushing while changing direction, kicking with both feet and the head, and throwing the ball with a certain strength are all indicators of their strength, stability in battles or duels, both on the ground and in the air

(Gardašević et al., 2018). Resistance training plays an important part, being one of the components of functional training in which players use their own body weight in all planes of movement. Presently in football, refining motor levels takes place on numerous levels, for example, through resistance training. Endurance training (ET) defined as the ability to perform an activity for a long period of time without reducing the effectiveness of this activity. Aerobic capacity that aids recovery between in the exhaustive power demanding sprints and high intensity bouts (Hoff & Helgerud, 2004).

Exercise to enhance endurance is known as endurance training (ET), and it entails strengthening the aerobic rather than the anaerobic systems. Due to their high mitochondrial content, type I muscle fibers significantly increase during endurance training. Exercises for endurance generate a decrease in actual muscle fiber size and no increase in muscle mass (Izquierdo et al., 2005).

Physical fitness can be defined as having enough energy to avoid fatigue and to enjoy life on a physical and emotional level. It is comprised of six skill-related components such as speed, power, agility, balance, reaction time and coordination. Performance-related fitness relates to skills that will improve an individual's ability to perform in athletic or sporting events, while health-related fitness is concerned with abilities that will help an individual achieve and maintain physical health (Sheppard & Young, 2006). One of the first studies examined the efficacy of CT in prepubescent age groups following an 8-week continuous exercise regimen. They claimed progress in performance in terms of standing long jump, ball throwing speed, and vertical jump length (Zemková & Hamar, 2018).

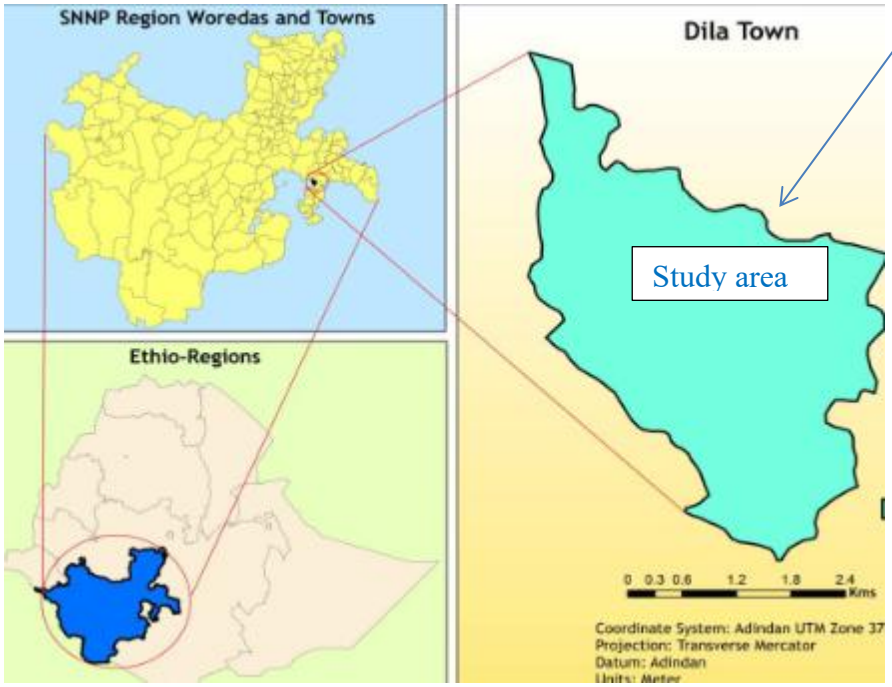
Adults' strength, muscular endurance, flexibility, and agility also demonstrated improvement (Arazi et al., 2011). It is essential to understand the consequences for athletes when designing a training schedule. Football players'

vertical jump improved more after eight weeks of CT than after football training alone (Wong et al., 2010). Helgerud et al. (2011) conducted a study on elite football players during their preseason, finding that combined training enhanced their countermovement jump, running economy, and 10 m sprint times.

2. MATERIALS AND METHODS

2.1Description of the study area

The study was conducted at Gedio Zone Dilla town, which is located in the south regional state of Ethiopia and 369 km far from Addis Ababa the capital city of Ethiopia and far 89km from Hawassa which is the capital city of Sidama. Dilla is the capital city of Gedio zone located in the main road from Addis Ababa to Nairobi. The town has a longitude and latitude of 6°24′30″N 38°18′30″E with an elevation of 1500 meters above sea level. And it became the major transfer and marketing point of coffee.



2.2Study design

The aim of this study was to investigate the effect of concurrent training on selected skill related physical fitness components in Dilla U-17 male football players. Depending on the nature and appropriateness of the pre and post test

data, the researcher was used experimental research design. The aim of experimental research was to look at the effects of an independent variable on a dependent variable. To use this research design effectively, you need to understand the terms independent and dependent variable. The independent variable affects the dependent variable (Kothari, 2004). The study aims to investigate the application of concurrent training and its impact on selected skill related physical fitness components. According to the objective and due to study participants were randomly assigned to either the experimental (EG) or the control (CG).

2.3Sample Size and Sampling Technique

According to Kothari (2004), "the ideal sample size of a target population is large enough to serve as an adequate representative and small enough to be selected economically in terms of time, the available budget for the research, its precision, and also the complexity of the analysis." This information was to determine the sample size of each target population. The researcher was selected U-17 male football project players in Dilla town using the census sampling method. After the pretest results are recorded, 12 EG and 12 CG assigned using simple random sampling techniques.

2.4Source of Data

The Dilla U-17 male football players' data was used as primary source of data. The primary source of data was collected through the administration of experimental process (recording pretest and post test result), the sample was taken from dilla U-17 male football players.

2.5Training protocol

Each training session involves a warm-up period, main practice session, and cooling-down activities followed by 30 to 50 minutes of low, moderate and high intensity exercises. Training increased the FITT over time. In this schedule,

concurrent training was including performance related physical fitness components such as speed, power, agility balance and etc. and the researcher was provided standard and appropriate concurrent training to improve the selected dependent variables, i.e., speed, power, and agility, after taking pre-test results from the trainers. Concurrent trainers' efforts to improve performance are aided by a systematically applied, gradually increased training load, intensity, and duration (Liu et al., 2025). The total duration of the experimental period was eight weeks. These concurrent training having different stations was developed by the research scholar, and the subjects were trained for the first three consecutive weeks (30 minutes and 3 days per week), for the second three consecutive weeks (40 minutes and 4 days per week), and for the last two consecutive weeks (50 minutes and 5 days per week) for eight weeks.

2.6Data collection instrument

Specifically, measurements for the experimental group and control group were taken twice, for the pre- and post-test of each trainer's fundamental concurrent training test. The researcher was provided a one-day introduction and practice regarding the process of conducting concurrent training tests. Before recording pretests for each and every concurrent training test, the trainers were able to make the test easy, simple, and time-efficient.

The following fitness test was recorded for the pre- and post-test studies, with the parameters being used to quantify speed, power, and agility.

2.6.1 Speed (30-meter Acceleration Test)

Purpose: The objective of this test is to monitor the development of the athlete's maximum speed.

Equipment: This test was required 400m track 60m marked section on the straight, Cone to mark 30m point, Stop watches and Assistant.

Procedure: The test comprises of 3 x 30m runs from a standing start and with a full recovery between each run. The athlete used the first 30m to build up to maximum speed and then maintains the speed through to 60m. The assistant was recorded the time for the athlete to complete the First 30m and Whole 60m. To determine the athletes flying 30m time subtract the time for the first 30m from the time for the whole 60m. The result was analyzed by comparing it with the results of previous tests.

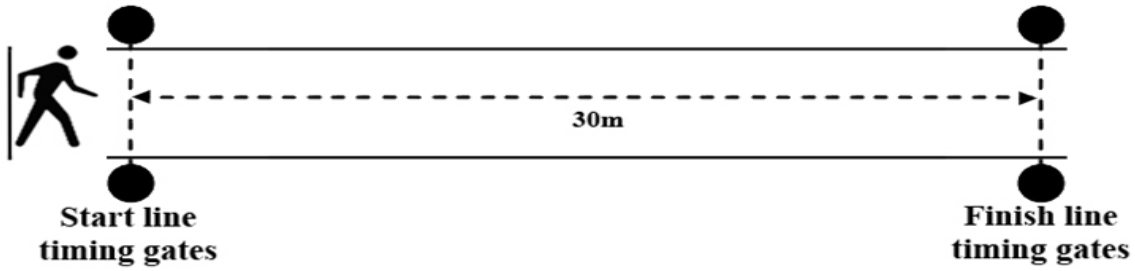


Figure 1: *30-meter Acceleration Test*

2.6.2 Power (Vertical jump test)

The objective of this test was to monitor the development of the Athlete's explosive power. These tests will require 1 meter tap measure, chalk and assistant.

Procedure: the athlete chalks the end of his fingertips, stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1), from astatic position jump as high as possible mark the wall with the chalk on his fingertips (M2), the coach measures the distance from M1 to M2. The test may perform as many times as the Athlete wishes. Analysis of the result was by comparing it with the result previous tests. It is expected that, with appropriate training between each test and the analysis was indicated an improvement (Kumsa, 2023).



***Figure* 2:** *vertical jump test*

2.6.3 Illinois Agility Test

Purpose: the objective of the Illinois Agility run test was to monitor the development of the Athlete's agility.

Required resources: flat non-slip surface, 8 cones, measuring tape, stop watch, whistle and assistant was required.

Procedures to conduct the test: This test was required the athlete to run the lines route in the diagram below as fast as possible.

The subject conducts warming up and dynamic stretching exercises for 10 minutes. The subject lies face down on the floor at the ''start'' line. Then the assistant gives the command ''Go'' and starts the stop watch. The subject jumps to his feet and negotiates the course around the cones following the line route shown in the diagram to the finish. The assistant stops the stop watch and records the time when the subject passes the ''Finish'' cone. Three successful trials were completed and finally the assistant was used the fastest recorded time.

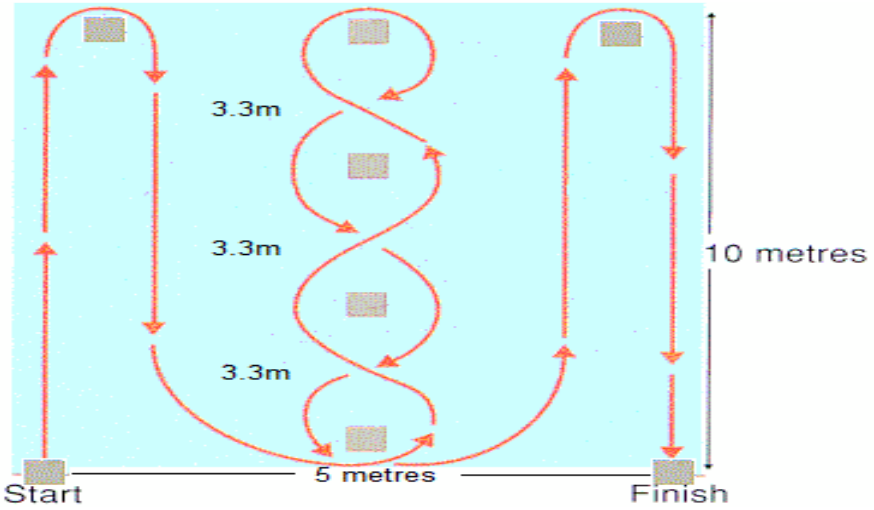


Figure 3: *Illinois agility test*

2.7Data Quality Control

To ensure the quality of the data, only the most common and standardized skill-related physical fitness components tests were used. The assistant skill test (recorders were trained to collect the appropriate data in order to reduce the errors during data collection). Furthermore, all of the aforementioned tests were videotaped and photographed for further verification of the test procedure. In order to obtain a true result, the data was managed by the researcher's prudence when gathering data. Even before the quality control stage, quality control was significantly improved data usability and helps reduce time and effort waste throughout the entire research workflow. To ensure data quality, all the test procedures, collection of data, and handling of information was carried out in accordance with standard protocols and measurements. The researcher was create awareness for subjects about the test and recommended preconditions, which they tried to do prior to taking the test. Furthermore, the researcher was tried to inform the control groups that they were not participating in training or exercises beyond their regular training so as to control them and increase the validity and reliability of the test results. Finally, the data was coded and faded

to the software twice, with different people handling it to avoid errors in data feeding.

2.8 Data analysis

The following statistical techniques were applied to find out the effect of concurrent training program on skill-related physical fitness components. Quantitative data analysis techniques were employed. The data collected from pre-test and post-test results were analyzed by descriptive statistics such as means and standard deviation; and inferential statistics such as independent sample t-test and paired sample t-test by using SPSS version (20.00). In all case, the criterion for statistical significance may set at 0.05 level of confidence interval ($p<0.05$)

3. RESULTS

After collecting the reliable data through experimental methods such as pre and post-test of each variable, the researcher tabulated, analyzed and interpreted it.

Table 1: the mean and standard deviation value of selected skills related fitness variables between experimental and control groups.

variables	Tests	Experimental group				Control group			
		Pre test		Post test		Pre test		Post test	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Speed	30 m acceleration	3.33	.492	1.58	.515	3.33	.651	3.50	.522
power	Vertical jump test	2.67	.651	4.42	.515	2.00	.739	2.00	.739
Agility	Illinois agility test	3.50	.522	1.58	.515	3.42	.515	3.25	.452

The above table 1 shows the mean and standard deviation values of experimental and control groups of pre and post tests on selected skill related fitness variables. The pre and post means and standard deviation of speed (30 m acceleration test) for EG and CG were (MD = 3.33, 1.58, SD =.492, .515 CG, MD =3.33, 3.50, SD =.651, .522) respectively. After an eight weeks concurrent training intervention, the players mean value of speed test results was increased when compared to pretest results i.e. the mean of EG increased from pre- test to post-test from 3.33 to 1.58(since the trainers can cover the given 30 m acceleration test within a short period of time and have above average value) due to the stated interventions.

Therefore, we are able to conclude that the eight weeks of concurrent training in the experimental groups had a beneficial outcome. However, as the above data indicates, the players' 30-meter acceleration test scores in the control group did not increase. i.e., the mean CG decreased from 3.33 to 3.50 between the pre- and post-tests.

The pre and post –means and standard deviation of power (vertical jump) for EG and CG were (MD= 2.67, 4.42, SD = .651, .515 and CG, MD = 2.00, 2.08, SD = .739, .739), respectively.

When compared to the mean value of the pre-test findings, the players' vertical jump test results increased after the intervention. That is to say, the eight weeks of planned concurrent training resulted in an increase in the mean of EG from 2.67 to 4.42 between the pre- and post-tests. As a result, we can say that the eight weeks of concurrent training in the experimental groups were successful. However, no change was observed in the control group, as shown in the above result.

The pre and post means and standard deviation of agility (Illinois agility test) for EG and CG were (MD = 3.50, 1.58 SD = .522, .515, CG, MD = 3.42, 3.25, SD = .515, 0.452), respectively. After eight weeks of concurrent training, the mean

result of Illinois agility test indicated an increase in the mean of EG from the pre-test to the post-test (from 3.50 to 1.58) as a result of the eight weeks of concurrent training that was scheduled. This implies that the eight weeks of concurrent training had a positive impact on the experimental groups, but the control group did not experience any change, as the above result shows.

Table 2: comparing pre- and post-test results of selected performance related physical fitness components of football players in controlled and experimental groups**.**

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	upper			
30 meter acceleration test	Experimental pre to post	.833	.718	.207	.377	1.289	4.022	11	**.002**
	Control pre to post	.250	.866	.250	-300	.800	1.000	11	**.339**
Vertical jump test	Experimental pre to post	-1.583	.900	.260	-2.155	-1.011	-6.092	11	**.000**
	Control pre to post	-.250	.452	.131	-.537	.037	-1.915	11	**.082**
Illinois agility test	Experimental pre to post	1.333	.778	.225	.839	1.828	5.933	11	**.000**
	Control pre to post	.083	.669	.193	-.341	.508	.432	11	**.674**

The above table 2, indicated that pre and post results of speed (30 meter acceleration test) showed a statistically significance difference in experimental group because the P- value is less than 0.005, which is 0.002. However, there was no significance change in control group as shown in the above table that means the p value is greater than 0.005, which is 0.339. Therefore, the researcher

concludes that eight weeks scheduled concurrent training had statistically significance improvement in the experimental group. However the control group didn't. The training had a great role in players' selection of skill related fitness variables. Due to this reason the null hypothesis was rejected.

The above result demonstrated that the specified eight weeks of concurrent training had a substantial positive impact on the experimental group's power training (P = 0.000). Since the experimental group's p value is less than 0.05 and there is a statistically significant difference (P = 0.000) between the pre- and post-measures, the eight weeks of concurrent training were essential for improving power. However, as the above table illustrates, the control group has not significantly improved (p = 0.082) on the player's power. This suggests that it is challenging to get players to improve to the required level without concurrent training programming. In this case, the null hypothesis is rejected.

The above table shows that the eight weeks of concurrent training significantly improved the agility skill level of the experimental group (P = 0.000). Because the experimental group's p value is less than 0.05 and there is a statistically significant difference (P = 0.00) between the pre- and post-measurements, it can be concluded that the eight weeks of concurrent training were crucial for improving the trainers' agility. However, as the above table demonstrates, the control group has not significantly improved (p = 0.674) on the players' agility. This suggests that it is challenging to encourage players to improve to the required level without planned concurrent training. Due to this reason, the null hypothesis was rejected.

Table 3: the results of Levene's Test for Equality of Variances for pre-test and post results of experimental and control group of football players.

Pre-test result for experimental and control group		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	**Sig. (2-tailed)**	Mean Difference	Std. Error Difference	95% of confidence interval of the deference	
									lower	upper
Variable's	30 m acceleration pretest = equal variance assumed	0.607	0.444	0.405	22	**0.689**	0.083	0.206	-.343	0.510
	Power pretest = equal variance assumed	0.482	0.495	-.373	22	**0.713**	-.083	0.223	-.546	0.380
	Agility pretest = variance assumed	0.820	0.375	-1.832	22	**0.081**	-.500	0.273	-1.066	0.066
Post-test result for experimental and control group										
Variable's	Speed posttest = equal variances assumed	0.000	1.000	-9514	22	**.000**	-2.000	.210	-2.436	-1.564
	Power posttest = equal variances assumed	0.607	0.444	3.647	22	**0.001**	0.750	0.206	0.323	1.177
	Agility posttest = variances assumed	1.294	0.268	-5.657	22	**0.000**	-1.333	0.236	-1.822	-.845

The assumption of equal variance between the two groups (experimental and controlled) is verified using Levene's test. Before beginning the eight-week planned concurrent training, this test was used to determine the players' current level of selected skill-related fitness (initial skill performance). Levene's test for equality of variances on Table **3** indicated that, for the pre-test results of players' speed, there is no significant difference (P = 0.689) between the experimental

and control groups because the p-value between the two groups is greater than 0.05. The experimental and control groups' pre-test results for the vertical jump test showed no significant differences (P =.713). As a result, given that the p value between the experimental and control groups was greater than 0.05, the eight weeks of concurrent training before the start of the programmed training demonstrated a statistically insignificant difference in the players' power. The pre-test results for agility (Illinois agility) did not show a significant difference (P =.081) between the experimental and control groups. Because the p value between the two groups was greater than 0.05, it was determined that there was no statistically significant difference in players' agility (Illinois agility) between the experimental and control groups prior to participation in programed concurrent training. In general, there is no significant difference between the experimental and control groups' results on the selected skill-related fitness component tests prior to participating in an eight-week program of concurrent training since all study subjects had no concurrent training program.

After an intervention, Levene's test is used to check the assumption of equal variance between the two groups (controlled and experimental). according to the results of Levene's Test for Equality of Variances from Table **3,the** players' 30-meter acceleration test showed a significant difference (P = 0.000) between the experimental and control groups,. The eight weeks of programmed concurrent training intervention showed a statistically significant difference in the players' speed between the experimental and control groups, since the p value between the two groups is less than 0.05. There is a significant difference (P = 0.001) In the vertical jump test between the experimental and control groups because the eight-week programmed concurrent training intervention demonstrated a statistically significant difference in players' power between the experimental and control groups, Since the two groups' p values was less than 0.05. There is a significant difference (P = 0.000) in agility (Illinois agility test) between the

experimental and controlled groups. So, the intervention of programed concurrent training showed that there is a statistically significant difference between the experimental and controlled groups on players agility, since the p value between the two groups is less than 0.05. Generally, throughout eight weeks of scheduled concurrent training, participants in the experimental group showed significant improvement in the selected skill-related fitness measures when compared to the control group. In this case, the null hypothesis was rejected.

4. DISCUSSION OF THE FINDINGS

The results of the analysis showed that regular concurrent exercise had a significant positive impact on the players' level of speed, power, and agility. After an eight-week concurrent exercise program, the experimental group in this study showed a significantly greater improvement than the control group in the selected physical fitness components ($p<0.05$) among the male football players. Thus, the following was discussed in relation to each variable's study findings:

4.1Speed

Based on the data analysis results, the experimental group showed statistically significant improvement in the 30m acceleration test from the pre-test to the post-test after the intervention of eight weeks of concurrent training, while the control group showed no improvement at all. In considering this, the study's findings indicate that there was a significant difference between the experimental group participants when compared to those of the control group. Because a significant difference was observed, the null hypothesis was rejected. This finding corresponds with numerous studies that show football players can cover up to 10 to 12 kilometers during alternating workouts that include a range of speeds.

As a result, the athletes must be able to engage in prolonged, hard exercise. Jens Bangsbo therefore created a test to aid in evaluating this endurance metric. With sporadic activity, the endurance test, which is unique to football, maximizes the aerobic energy system. According to Kelly (2019), the concurrent anaerobic system must work harder to meet the demands of the concurrent aerobic system. Player's complete 20-meter shuttle runs with a progressive speed increase as part of the endurance test. After a set of runs, they have a 10-second active rest period before continuing until they are unable to maintain the requisite pace (Billat, 2001). Previous research has demonstrated how crucial it is for athletes to have aerobic capacity. According to Faude et al. (2013), high-intensity movements determine the outcome of most football games. Players must be able to accomplish these actions frequently without degrading their effectiveness. The weaker correlation with strength qualities may be explained by the variety of running speed and technique in the sprint activities, according to Hermassi et al. (2019). In one of the first studies to look at the impact of CT on sport-related performance in prepubescent age groups, running speed, agility, power, and various fitness levels of adolescents were found to improve after 8 weeks of continuous exercise.

4.2 Power

Based on the data analysis results, the experimental group showed statistically significant improvement in the vertical jump test from the pre-test to the post-test after the intervention of eight weeks of concurrent training, while the control group showed no improvement at all. In considering this, the study's findings indicate that there was a significant difference between the experimental group's participants when compared to those of the control group. Because a significant difference was observed, the null hypothesis was rejected. Numerous research studies and articles in the field of sports science have supported concurrent power training, with a particular focus on improving

vertical jump ability, a conditioning program that incorporates weight training and plyometric exercise can improve power performance in the 40-yard sprint and vertical leap (Rebold, 2011). A faster athlete does better on tests that evaluate power performance traits, such as the squat leap and countermovement jump. According to Kalkhoven et al. (2023), jumpers' powerful leg forces can play a big part in how their hamstring muscles develop. Increases in speed, as measured by the 50-meter sprint test, and improvements in jump performance interact (Wheeler Botero et al., 2023). Our findings suggest that a stronger lower limb force would have aided in the feet touching the ground faster and for a shorter period of time.

4.3 Agility

As a result, this study demonstrated that, when comparing the experimental group participants to the control group, there was a significant difference in the Illinois Agility Test scores from several perspectives. Players with a high agility profile are more likely to perform better during high-speed repeated activities and to make quick decisions during crucial moments during the game, according to Zemková and Hamar (2017). This finding has been supported by numerous studies and suggests that agility is the most important determinant of soccer performance. The two primary components of the agility model are change of direction speed and perception and decision-making characteristics. Based on cognitive processes, perceptual and decision-making elements include particular abilities including visual scanning, anticipating, recognizing patterns, and situational awareness (Sheppard & Young, 2006). Physical factors such as technique, straight sprinting speed, and leg muscle quality determine the change of direction speed. Anthropometry, strength, endurance, power, and reactive agility (Sheppard & Young, 2006).

5. CONCLUSION

The results of this investigation show that the eight weeks of concurrent training significantly improved the study subjects' performance (Dilla U-17 male football players). The eight-week planned concurrent training program significantly improved the study subjects' speed, power, and agility. The study's results showed that an eight-week concurrent training program significantly improved the experimental group's performance in all measurements (speed, power, and agility).

Abbreviations

CT: Concurrent Training

ET: Endurance Training

EG: Experimental Group

CG: Control Group

SPSS: Statistical Package for Social Science

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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