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Research Article

Effect of Concurrent Training on Selected Physical Fitness of Middle Distance Runners

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Abstract

The purpose of this study was to examine the effect of concurrent training on cardiorespiratory endurance, flexibility, and speed in middle distance runners. The study used an experimental research design. All twenty-six (26) Awuscod middle-distance-Runners were given EG and CG and randomly separated in two equal groups. Both (EG= 13) and (CG= 13) completed PT and POT of the 12-minute run test, sit-reach test, and 30-meter acceleration test to assess cardiorespiratory endurance, flexibility, and speed, respectively EG participated in an additional ten weeks of concurrent treatments While the CG conducted their routine training. The data gathered from the study subject were analyzed using SPSS Version 25 Software, using descriptive statistics (mean and SD) and inferential statistics (paired t-test and independent) and Ten weeks of concurrent training significantly enhanced cardiorespiratory endurance and speed ($p<0.05$). But no significant variation was observed in flexibility. Furthermore, no significant differences have been observed in any of the CG-Factors ($p>0.05$). Based on these findings, it is possible to conclude that 10 weeks of simultaneous exercise improve cardiorespiratory endurance and speed of physical fitness components. As a result, the study recommended that runners incorporate concurrent training in their middle distance athletic-training- program to improve their cardiorespiratory endurance und speed.

Keywords

Concurrent Training, Cardiorespiratory Endurance, Flexibility, Speed

1. Introduction

Athletics is a popular sport all over the world that primarily consists of running, jumping, throwing, and walking [1], Running is also popular; a wide range of in disciplines such as track, road, mountain, and ultra-endurance running [2, 4].

Middle-distance events are traditionally defined as track events that fall between short-distance events like the 100m, 200m, 400m, and longer distance events like the 10000m, half-marathon (21.1km), and marathon [3, 4].

African athletics was introduced to the world at the 1960 Olympic Games. Ethiopian and Kenyan athletes have dominated middle- and long-distance events in athletics since the 1968 Mexico Olympics; this dominance has been attributed to physiological, anatomical, psychological, traditional, social, and cultural factors [5].

Athletics in Ethiopia athletes have been shining in the world of athletics since the legend Abebe Bikila laid the groundwork for Ethiopians and all black Africans to be gold medalists at the 1960 Rome Olympics [6-10].

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Physical fitness is the body's ability to perform moderate – to- vigorous levels of physical activity without becoming fatigued (Corbin, 2020). Physical fitness components such as endurance, speed, strength, and flexibility are factors that influence overall athletic performance [11, 12, 7].

Regular physical training is critical for the health and wellbeing of all athletes. It can improve athletes' functioning and physical fitness level [13].

Concurrent training is a program that combines resistance and endurance training to maximize all aspects of physical performance, Unless an athlete is competing in a pure-endurance sport such as long distance running or a combination of power and endurance attributes are required to excel in mixed-type sports [15]. Some recently studies recognized that combining strength and aerobic training in the same session provides more benefits for neuromuscular and cardiorespiratory functions [13, 12, 7].

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Debre Tabor City, which is located in the north of Ethiopia in the Amhara Region, specifically in Kimir Dingay, which is 108 kilometers from Bahir Dar, the capital city of the Amhara Region, and 592 kilometers from Addis Ababa, Ethiopia's capital city. It is located at 11°51′N 38°1′E and has an Elevation of 2,706 Meters above sea level.

2.2. Study Design

Based on the nature and purpose of the study, an experimental research design was adopted to carry it out. The study used PT- and POT-data to modify the cause-and-effect relationship between independent and dependent variables. The study included twenty-six middle-distance-athletes, who are currently involved in an athletics club. For the purposes of this study, census sampling was used. All Twenty six middle distance runners 14 men and 12 women from those athletics club Using simple random sample techniques, the EG consisted of 13 athletes, whereas the remaining 13 athletes were included in the CG because they were not engaging in the intended training program. Additionally, the researcher gathered primary data in the field in the form of PT- and POT-Measurements of both EG and CG at the beginning and completion of the training session.

2.3. Measurement Tools and Procedures

All participants in the study received their first medical checkup. Runners were familiar with the tests and took them at least once before participating in the current study. Testing was done at the same time of the day and in the same field for Pre- and Post-Testing. Anthropometric information such as age, height, weight, and assessment were collected first. Performance testing included a 12-minute run test for cardiorespiratory endurance, a sit-and-reach test for flexibility, and a 30-meter acceleration test for speed. Prior to testing, the participants were given the same supervised warm-up protocol, which included ten minutes of jogging, walking, synchronized movement of the hands, legs, and arms, and dynamic exercise. As a result, the experimental group engaged in different days of concurrent training in addition to running training, and they proceeded with their usual training. After 10 weeks of concurrent instruction, both testing periods were repeated.

2.4. Methods of Data Analysis

The quantitative Data was acquired using Fitness-Tests. The PT- and POT-results were analyzed using descriptive and inferential statistics such as means, SD, independent sample t-tests, and paired sample t-tests in the statistical package for social science (SPSS) version 25.00. P-values for statistical significance were fixed at <0.05.

3. Results

The analysis of data collected from study samples, as well as the outcomes, was described. The study sought to explore the effect of 10 weeks of concurrent training on the cardiorespiratory endurance, flexibility, and speed of middle distance runners. A pretest of cardiorespiratory endurance (12-minute run test), flexibility (sit and reach test), and a 30-meter acceleration test were administered. All trainees continued their athletic training; however, half of them were randomly selected and given 10 weeks of concurrent training, 3 times a week. And tests were given after 10 weeks of concurrent training. Then, at the end of 10 weeks of concurrent training (post), similar tests were given to all twenty-six male Middle-distance-Trainees, regardless of their groups, in order to determine whether concurrent training affects cardiorespiratory endurance, flexibility, and speed of Middle-distance-Trainees. The findings acquired following a 10-week concurrent training program are shown in tables below. Table 1 show Demographic Characteristics of Study Participants, Tables 2, 3, 4 shows the Descriptive statistics for cardiorespiratory endurance, Flexibility and speed test results respectively and tables 5 and 6 shows Paired and Independent Samples t-Test for Study.

The abbreviations used in the research were as follows: Experimental Group (EG), Control Group (CG), mean difference (SD), pretest (PT) and Post test (POT).

Table 1. *Demographic Characteristic of Study Participants.*

Group	N	Age (in year)	Height (in meter)	Weight (in kg)
		Mean ± SD	Mean ± SD	Mean ± SD
EG	13	21.31±630	1.6923±08852	52.4615±6.14567
CG	13	21.00 ±1.000	1.6777±1.09719	50.38 ±3.776

SD=standard deviation, N=number of Participants in a group, EG=Experimental groups, CG=control groups.

Table 2. *Descriptive statistics of cardiorespiratory endurance.*

Subjects								
Test	**EG (n=13)**				**CG (n=13)**			
12 minute run test	**Mean**		**SD**		**Mean**		**SD**	
	PT	**POT**	**PT**	**POT**	**PT**	**POT**	**PT**	**POT**
	3588.46	3728.846	311.0157	274.2121	3530.769	3480.769	341.8933	321.8038

The table 2 shows that the mean and SD of the EG and CG of the 12-minute run test. The mean values of the 12-minutes run PT and POT of the EG were 3588.4615m and 3728.8462m, and the SD was 311.01571m and 274.2121m respectively. Whereas the mean values of the CG 12-minutes run test were 3530.7692m and 3480.7692m, while their SD were 341.89330m and 321.80381m respectively, this reveals that improvement were observed in the EG cardiovascular endurance, After intervention the mean of EG in athletic trainees was increased on PT to POT from 3588.4615 to 3728.8462 EG due to the ten weeks concurrent training, but improvements were not seen on the CG side.

Table 3. *Descriptive statistics of Flexibility.*

Subjects								
Test	**EG (n=13)**				**CG (n=13)**			
Sit and reach test	**Mean**		**SD**		**Mean**		**SD**	
	PT	**POT**	**PT**	**POT**	**PT**	**POT**	**PT**	**POT**
	14.8462	14.9231	5.7857	5.7945	15.846	15.923	6.0117	5.83754

Table 3 indicates that the mean and SD of the sit and reach test PT and POT results of both EG and CG. The mean values of the EG, PT and POT result sit and reach test were 14.8462cm and 14.9231cm and their SD were 5.78570cm and 5.79456cm respectively. On the other hand the mean values of the PT and POT results CG sit and reach test were 15.8462cm and 15.9231cm, while their SD were 6.01174 and 5.83754 respectively. This indicates that there were no change in the mean values of EG sit and reach test results from PT to POT (14.8462cm to14.9231cm). On the other hand, the mean values of the CG were homogenous from PT to POT result (15.8462 to 15.9231).

Table 4. Descriptive data between pre and post- test of speed.

Subjects								
Test	EG (n=13)				CG (n=13)			
30meter acceleration test	Mean		SD		Mean		SD	
	PT	POT	PT	POT	PT	POT	PT	POT
	4.3538	3.3577	0.37340	0.82540	4.5292	4.6231	0.49461	0.5485

Table 4 indicated that the PT of EG and CG mean value of speed was 4.3538 and 4.5292 which indicates that the PT mean value was almost the same for both group of speed fitness. Before training there was no change between the two groups. But in the POT mean value of EG and GC was 3.3577 and 4.6231 which show there was moderate change between EG and CG of the POT result because of the ten weeks concurrent training. There was indicated moderate improvement of speed fitness level.

Table 5. Paired Samples t-Test for Study Variables.

Variables	Subjects		Paired difference				T	Sig.(2-tailed)
			Mean	Std.d	95% confidence interval Lower	Upper		
12-minute run test	EG	POT-PT	140.38462	83.87644	89.69859	191.0706	6.035	0.00
	CG	POT-PT	50.00000	106.06602	-114.095	14.09505	-1.700	0.115
Sit-reach test	EG	POT-PT	0.07692	0.95407	-.49962	0.65346	0.291	0.776
	CG	POT-PT	0.07692	1.03775	-.55018	0.70403	0.267	0.794
30Meter Acceleration Test	EG	POT-PT	-.99615	0.82816	-1.49660	-49570	-4.337	0.001
	CG	POT-PT	0.09385	0.18800	-.01976	0.20745	1.800	0.097

Table 5 demonstrates the MD and SD values of cardiovascular endurance variables, EG (MD=140.38462 SD=83.87644, CG, MD=50.00000. SD=106.06602), respectively. p value was 000. So, after Concurrent interventions in cardiovascular endurance variables the POT measurement on EG show significance differences since P-value is less than 0.05. So, alternative hypothesis is accepted. This value indicates that cardiovascular endurance of the EG shows a statistically significance improvement from PT to POT results ($p < 0.05$) but not in CG ($p > 0.05$). Likewise, the MD and SD values of the EG and CG pre and post- test result Sit- reach test were 0.07692, 0.95407, and.07692, 1.03775 respectively. This indicates that EG hadn't been significantly improved (P= 0.776) on flexibility by concurrent training. So that EG didn't show a statistical significance difference between PT and POT measurements. This means those ten weeks concurrent intervention was not vital for improvement of flexibility, since p value of EG is greater than 0.05. Table 5 demonstrates the mean and SD values of speed variables. There was significance difference 30 Meter Acceleration test from PT to POT for EG after ten weeks concurrent training. Because mean = -.99615 SD=0.82816, T = -4.337 and P = 0.001 for CG and Mean =0.09385, SD= 0.18800 T = 1.800 and P = 0.097for EG. So when P< 0.05) which indicates that the group members who had ten weeks concurrent training programmed (EG) were performed better than the CG who had not participated in ten weeks concurrent training. This means that ten weeks concurrent training intervention was vital for improvement of speed.

Table 6. *Independent Samples t- test between experimental and control group.*

Variable Equal variances assumed	Levine's Test for Equality of variances		t-test for Equality of Means						
	F	Sig	T	Df	Sig.2 Taile d	Mean Difference	Std. Error Difference	95% ConfidenceInterval of the Difference	
								Lower	Upper
12-minute run test	0.27	0.604	2.116	24	0.045	248.0769	117.2603	6.06336	490.0904
Sit and reach test	0.106	0.748	-.438	24	0.665	1.00000	2.28126	-5.7082	3.70829
30 Meter Acceleration Test	3.237	0.085	-4.604	24	0.000	-1.26538	0.27487	-1.83270	-.6980

Levine's Test is used to check the assumption of equal variance between the two groups (EG and CG) after intervention. It is tested by using F-test. The results of Levine's Test for Equality of Variances from table 6 showed that: There is significance difference (P=0.045) between EG and CG for cardio-respiratory fitness. So that, of concurrent training has shown a statistical significance difference between EG and CG on cardiorespiratory fitness, since p value between two groups is less than 0.05. And also There is no significance difference (P= 0.665) for sit-reach test between EG and CG for flexibility. So that, of concurrent training didn't show a statistical significance difference between EG and CG on flexibility of participants, since p value between two groups is greater than 0.05and also There is significance difference (P=0.000) for 30 Meter Acceleration speed test between EG and CG for speed. So concurrent training has shown a statistical significance difference between EG and CG on speed of participants, since p value between two groups is less than 0.05. Therefore, the assumption of equal variance between groups is satisfied, because the p-value of Levine's assumption of equal variance for those two variables is less than 0.05. Therefore, alternative hypothesis is accepted for the cardiorespiratory fitness, and speed between two groups. But null hypothesis is accepted for flexibility. This implies, EG is better than CG on cardiorespiratory fitness, and speed because of concurrent training intervention.

4. Discussions

The study's findings reveal that there was a considerable improvement in cardiovascular endurance as a result of concurrent training among athletic trainees when compared to the 12-minute-Run-Test (P = 0.00). When we compared the mean score of the EG's 12-minute-run-test results before concurrent training to the mean score after 10 weeks of concurrent training, a significant difference occurred.

The concurrent training provided to the athletic trainees resulted in a progressive increase in the mean of athletes from PT to POT. Since improvements in EGs cardiovascular endurance-fitness level have been seen, some research indicates that 10 weeks of concurrent training have beneficial benefits on the cardiovascular endurance of 1500m-track-and-field-athletes [1-4]. And also 12-week concurrent training improves in maximal oxygen uptake (VO_2 max) of a runner [2, 3] But Some studies have shown that concurrent training inhibits the development of strength and power of middle distance athletes, but does not affect the development of aerobic fitness when compared to either mode of training alone [1, 2]. But. Some studies have found that combining strength training and aerobic training in the same session and in this order provides more benefits for neuromuscular and cardiorespiratory functions of track runner [2]. In addition to these some research has been shown to after eight weeks concurrent training increase vo2max, especially in prepubescent children athletic trainee [4, 12-14], and also the finding of these study revealed that concurrent training showed improvement on cardiovascular endurance on athletic trainees. Those and other many findings supported the result of this study.

In the instance of the effects of concurrent training on the flexibility of middle distance athletic runners, there was no significant difference between PT- and POT-scores in EG when tested in a sit-and-reach test, and there was no significant improvement after the intervention. The sit-reach test between EG and CG for Flexibility yielded a P-value of 0.665. When we compared the mean score of the EG's sit-reach test results before and after 10 weeks of concurrent training, we found no significant difference. The training provided to athletic trainees did not result in a steady increase in the mean of athletes from PT to POT. This conclusion contradicts previous research. The study's findings show that there was no significant improvement in lower-body-Flexibility as a result of concurrent training among

middle-distance-athletic-trainers, who switched from EG to CG and PT to POT in EG. So, EG did not show a substantial improvement over CG. However, other research contradicts these findings, indicating that a concurrent training program can greatly enhance the flexibility of track and field athletes [4, 6-10]. In addiation to these Concurrently ten weeks training interventions, strength training before endurance training, strength training after endurance training group have produced significant improvement on flexibility, of junior sprinter athletes [11-14], But other research supported to these finding of study, 8 weeks concurrent training has no significant changes in lower body flexibility in female athletic track runner. [1-4] Because of those and other unknown reasons, the result of this study didn't show a statically significant improvement on lower body Flexibility. The result of the study indicates that there was a significant improvement on speed due to the effect of concurrent training among athletic trainees so, EG were significant improvement for PT to POT exercise on concurrent training for middle distance athletic runner. Those, as it is indicated the average value of speed was significantly decreased(improved) for the EG after 10-weeks designed concurrent training program, the mean value of speed for EG was 4.3538 before they participate to a ten weeks concurrent training program and after they begin(start) and finish the ten weeks concurrent training program the mean value of speed became 3.3577 when compared to the mean value of speed for CG pretest mean value was 4.5292 and 4.6231 was post mean value of speed which was taken as PT and POT result respectively with the mean value difference were considered statically significant at $p \leq 0.05$. So, as we can say that there was significance change in speed of POT result on EG because of 10-week concurrent training. Besides in the CG there was a little difference from PT to POT result but not significance when compare to the EG within ten weeks 'concurrent training. Therefore, based on this result 10-weeks concurrent training has a better effect on speed of middle distance runner. That means the null hypothesis was rejected while the alternative hypothesis was accepted. And other researches to support these finding of study, effective 8 weeks of continuous concurrent training program was improve in performance of running speed, and different fitness levels of adolescents track runner [13] and also concurrent training have positive effects for maintaining and optimising speed fitness levels of track athletes [10-12] Concurrently the strength training before endurance training, have produced significant improvement on speed track athletes [1, 2] and 8 week concurrent training has significant effect on speed fitness level on female long and middle distance track runner [15]. The finding of these study revealed that ten weeks concurrent training showed improvement on speed of middle distance athletic trainees. Those and other many findings supported the result of this study.

5. Conclusions

The study found that 10 weeks of concurrent training had a relative beneficial effect on cardiovascular endurance and speed in middle-distance trainees, as determined by the 12-minute-run-test and the 30-meter-Acceleration-Test. The study found that 10 weeks of concurrent training did not significantly increase the flexibility of middle-distance-trainers. This Study's findings have a substantial impact on the Enhancement of Physical Fitness in Middle-distance-Trainees. In general, following 10 weeks of concurrent training, middle-distance-runners showed statistically significant improvements in cardiovascular endurance and speed.

Abbreviations

CG	Control Group
EG	Experimental Group
MD	Mean Difference
N	Number
POT	Post Test
PT	Pre Test
SD	Standard Deviation
SPSS	Statistical Package for Social Science

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Conflicts of Interest

The authors declare no conflicts of interest.

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