

# Effects of Aerobic and Plyometric Exercises Training on Physical Fitness and Related Physiological Variables of Ambo Secondary School Male Teachers, Oromia, Ethiopia

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**Abstract:** Aerobics is a form of physical exercise that combines rhythmic aerobic exercise with stretching and strength training routines with the goal of improving all elements of fitness and similarly plyometric training is broadly used to improve physical performance in many sports activities involving sprinting, jumping and change of direction ability. The purpose of this study was to investigate the effect of aerobic and plyometric exercises on physical fitness and related physiological variables of Ambo secondary school male teachers of Ethiopia. Twenty two (n=22) male teachers were selected as the subject of the study based on the inclusion and exclusion criteria. Aerobic and plyometric exercise training program for 12-weeks were arranged for the subjects. Pre-post training program tests were conducted on the dependent variables. After coded and tabulated the tested data, the results were analyzed using descriptive statistics and paired sample t-test to find the significant difference between mean and  $\pm$ SD values of the participants of the study. The analyzed data on time duration for 30m speed and Illinois agility testes were improved with average mean difference of 0.92sec and 1.3 with ( $p < 0.000$ ), the numbers one minute push up test was improved by 6.17 ( $p < 0.000$ ), the height of VJ test the results is improved by 5.96cm, SBJ distance test improved by 1.82m ( $p < 0.000$ ). On the related physiological variables the  $VO_2$ max test results were improved by 7.50ml/kg/min mean differences were observed, the RHR result were improved with 5.95bpm, lastly the SBP and DBP were decreased by 8.32 and 5mmHg respectively. It was concluded that 12-week combined aerobic and plyometric exercise significantly improve aerobic and plyometric tests variables of selected for this particular study.

**Keywords:** Aerobic Exercise, Plyometric, Physical Fitness, Physiological Variable

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## 1. Introduction

Physical activity and exercise as an important part of a healthy lifestyle. Recent scientific evidences reported that regular physical activity and exercise involvement has wide range of physical as well as mental health benefits [1-4]. Previous literature has demonstrated that strong relationship between physical activity and risk for several chronic diseases, including coronary heart disease, hypertension, non-insulin-dependent diabetes mellitus, osteoporosis, and colon cancer [14]. Our body requires energy for all types of activities, and the demand is met by burning off the food we ingest [7, 8, 9]. Exercises that focus on breathing quickly and efficiently have many excellent advantages, including

strengthening the heart muscle [2, 11, 12]. The term "aerobic exercise" refers to a range of physical activities that stimulate heart and lung function for an amount of time long enough to result in positive physical changes [14-17]. An exercise that incorporates or enhances the body's oxygen consumption is referred to as an aerobic exercise. Numerous forms of exercise are aerobic in nature, which means that they must be done for long periods of time with moderate degrees of intensity [22-24]. Beside to this exercises classified as aerobics or endurance involves using powerful muscle groups repeatedly and rhythmically for extended periods of time. By engaging in aerobic exercise, the entire body is utilized, including the arms, legs, and trunk [21, 19, 20]. Although the heart rate rises significantly during aerobic

exercise, it never reaches its highest point. Muscles can always get enough oxygen-rich blood from the heart to use fat and glycogen for aerobic energy production [10-12].

Similarly plyometric is a type of exercise training that uses speed and force of different movements to build muscle power. Plyometric training can improve your physical performance and ability to do different activities. The aerobic system supplies energy at a slow, steady rate, more blood is sent to the active skeletal muscles, and, as body temperature increases, more blood is sent to the skin whereas plyometric increase neuromuscular coordination by training the nervous system and making movements more automatic during activity (training effect) [13, 27, 28]. This is known as reinforcing a motor pattern and creating automation of activity, which improves neural efficiency and increases neuromuscular performance. By desensitizing the GTO, plyometric exercises allow muscles to generate force by having the musculoskeletal system tolerate increased workloads without the GTO firing [12]. The increase in performance often occurs without a concomitant increase in morphological changes within the muscle [12, 14, 24]. These training affects the neural system predominates in the first six to eight weeks of any training program, and then after several additional weeks, hypertrophic changes of the muscles begin to occur. Combining aerobic and plyometric exercises into our regular active life have so many benefits as individual and in group since aerobic exercises are endurance-type exercises that increase a person's heart and breathing rate over a sustained period and plyometric as anaerobic exercises involve short, intense bursts of physical activity. Both types of exercise are beneficial for a person's cardiovascular health and mental health benefits that key indicator for our health status [21-25]. The center for Disease Control and prevention has established specific physical activity recommendations for older adults to achieve important health benefits [4, 5, 17, 19]. Adults and older adults are encouraged to attain at least 159minutes of moderate intensity physical activity per week, recognizing that more activity has more robust health benefits. The CDC also recommends muscle group strengthening exercises on two or more days per week that address all the major muscle groups [18, 20, 23]. Adults should limit the amount of time spent being sedentary, replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits [3, 10, 11, 15]. To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity [4, 5, 6]. Recent technology advancements have reduced the physical demands of day-to-day activities like washing, cleaning and going to work places. Automation has made more time available for leisure pursuits. Unfortunately, most of the new found leisure time is used for sedentary pursuits, whereas human body is designed for strenuous physical activity[5-8]. This has resulted in the decline of functional ability of the human body. Exercise scientists and health professionals strongly believe that this increased physical inactivity has led to a rise in the incidence of several degenerative diseases such as coronary heart disease

(CAD), diabetes, hypertension, obesity and overweight, osteoporosis, osteoarthritis and some forms of cancer [12, 14, 23]. This trend has led to the deterioration of health and increase in the prevalence of these diseases especially, among the adults, aged, retirees, top executives (in both public and private sectors [16-18]. The current research results strengthen the productivity and even reduced longevity, because of inability to acquire the components of physical fitness, through a thorough participation in moderate to-rigorous physical activities. Therefore, the main aim of this study was to answer for the following questions 1. Does twelve-weeks aerobic and plyometric exercises training have significant effects on the time duration to complete 30m sprint speed and Illinois agility tests of indicated high school male teachers? 2. Does twelve-weeks of aerobic and plyometric training significantly improve the number of one minute push up tests and distance of SBJ and VJ tests of indicated high school male teachers? 3. Does twelve-week of aerobic and plyometric exercises training have an effect on the resting heart rate and blood (SBP and DBP) pressure of indicated Secondary school male teachers? 4. Does twelve-weeks of aerobic and plyometric exercises training can improve  $VO_{2max}$  of indicated secondary school male teachers?

## 2. Materials and Methods

### 2.1. Design of Research

This study used one group pre-post experimental research design. For many experimental designs- the pretest-posttest, designs are preferred methods to compare participant groups and measure the degree of change occurring as a results of treatments of interventions.

### 2.2. Subjects of the Study

The total population of the study was (N=52), of which (n=32) male teachers were selected using the inclusion and exculcation criteria arranged by the researchers. Using the baseline fitness tests, teachers were assigned into the training program (n=22) male teachers. In order to be participated in the study, the teachers had to sign a consent form and be free from metabolic sidearm, chronic diseases' and injuries, their age less  $\leq 45$  years. Participants were recruited from male teachers of the indicated secondary school having no any structured physical exercises program involvement and leading sedentary life style except their regular life and teaching activities, the female counter parts are entirety interested for their personal issues. The intervention period lasted 12-weeks from March to May 2023).

### 2.3. Training Protocol

Participants in the aerobics and plyometric training were performing their task immediately after the proper warming-up guided by the research teams. The interventions or treatments were performed for twelve weeks, three days per week and minimum for 45-60mint per session. Participants have no any additional such structured exercises training within this time duration moreover free from any exercises routines that were

identical for every participant, except this exercises training program. The experiment consisted of two test sessions (pre and post exercise test) and two interventions (aerobic and plyometric). Pre-tests were performed two days before the beginning of training and it contained field tests (30m sprint tests, numbers of one minute push up tests, Standing broad jump tests, height of vertical jump test and Illinois agility test) to evaluate all tests respectively. Similarly resting heart rate, systolic and diastolic blood pressures and 12minute-cooper tests were conducted with the assistance of health professionals. Then, those programs were followed by post-tests, two days after the last training session. All testing sessions began with a dynamic stretching of all muscles with warming up and at the end, cooling down.

#### 2.4. Test Procedures

In each group, all participants were instructed to maintain their usual life style, physical activity and their usual diet. After the 12-weeks intervention period, all dependent variables (anthropometric, selected physical fitness, related physiological variables) data were collected again, using the same conditions and by the same evaluators.

#### 2.5. Data Analysis

The data gathered through pre-test and post-tests were

coded and arranged for analysis. The pre and post-test results were presented as mean,  $\pm$ SD. The coded and arranged data were analyzed by using paired t-test to see performance changes in both groups from baseline (pre-test) to post-test and independent t-test to identify performance differences between the groups. The researchers also used SPSS version 23.0 software to describe, compare, summarize and analyze the changes in the dependent variables. The level of significance was set at  $p \leq 0.05\%$ .

### 3. Results and Discussion of the Study

#### 3.1. Result

During the 12-weeks intervention period, no issues and injuries were reported among the experimental groups. All subjects effectively and efficiently completed the training program. Therefore 22 Ambo secondary school Male teachers were fully completed the training program designed for the study. The values of all dependent variables selected physical fitness were (30m sprint time, number of one minute push up test, distance of SBJ and VJ, time duration for Illinois agility tests. Similarly the related physiological variables, resting heart rate, SBP& DBP and  $Vo_{2max}$  were tested before and after the intervention period are presented in table 1, 2, 3, below respectively.

*Table 1. Demographic characteristics of sampled high school teachers.*

Variables	N	Before Training		After training		t	P-value
		Mean	SD	Mean	SD		
Age (years)	32	32.27	7.43	32.27	7.43		
Height (cm)	32	1.70	0.03	1.70	0.03		
Body Mass (Kg)	32	70.59	3.29	68.81	3.24	19.38	*0.000
BMI (kg/m <sup>2</sup> )	22	24.34	0.95	23.70	0.94	14.99	*0.000

As we can see from table 1 above, the demographic characteristics of teachers of identified secondary school have an average mean age and height 32.27 years,  $SD=7.43$  and 170cm,  $SD=7.43$  respectively, while their body mass and body mass indexes were improved from 70.59 kg to 68.81kg,

$SD=3.29$  to 3.24 and 24.34 kg/m<sup>2</sup> to 23,70kg/m<sup>2</sup>,  $SD=0.95$  to 0.94 respectively with the average mean differences of 1.78 and 0.64 due to the effects of arranged training program. The level of significance ( $P<0.000$ ) in both body mass and BMI.

*Table 2. Descriptive Statistics of the pre-post test results on the selected physical fitness.*

Variables	No	Pre Training		Post Training	
		Mean	SD	Mean	SD
30m Speed Test	22	6.55	0.51	5.63	0.53
One minute Push Up test (No)	22	12.36	1.83	19.13	2.12
SBJ Test (meter)	22	1.90	0.16	2.24	0.14
Vertical Jump test (cm)	22	53.18	14.27	71.59	12.08
Illinois Agility Test (Sec)	22	17.74	0.76	16.44	0.43

The above table 2, describes the performances of Ambo secondary schools male teachers on selected physical fitness identified for this particular study such as, time duration for 30m

sprints test, maximum numbers of one minute push up test, distances of standing broad jump test, height of vertical jump tests and time duration to complete Illinois agility tests were.

*Table 3. Descriptive Statistics of the pre-post test results of related Physiological variables.*

Variables	No	Pre Training		Post Training	
		Mean	SD	Mean	SD
Resting Heart Rate (bpm)	22	75.81	4.00	69.86	4.02
SBP (mmHg)	22	131.13	5.33	122.81	3.98

Variables	No	Pre Training		Post Training	
		Mean	SD	Mean	SD
DBP (mmHg)	22	74.09	6.10	69.09	6.66
Vo2max	22	29.27	3.37	37.32	2.93

\*bpm- bet pre minute, SBP-systolic blood pressure, DBP-diastolic blood pressure, mmHg-millimeter mercury

From the above table 3, we observe that, the mean test results of identified physiological variable such as resting heart rate per minute, blood pressure (SBP and DBP) in mmHg and 12-minute cooper run test for maximum oxygen consumption of the study subject of this particular study were

improved from RHR=75.81 to 69.86 bpm, with SD=4.00 to 4.02, SBP=131.13 to 122.81mmHg, with SD=5.33 to 3.98, DBP=74.09 to 69.09 mmHg, SD=6.10 to 6.66, Vo2max=29.27 to 37.32, with SD=3.37 to 2.93 respectively.

**Table 4.** Paired sample t-test results on selected physical fitness variables of Ambo secondary school male teachers.

Variables	Std. Error mean	95% CI of difference		t	df	P-value
		Lower	Upper			
30m sprint speed test (sec)	0.062	-0.78	1.04	14.61	21	*0.000
one minute push up tests (No)	0.29	-7.38	-6.16	-23.05	21	*0.000
SBJ Test (m)	0.025	-0.38	-0.28	-13.17	21	*0.000
VJ Test (cm)	1.41	2.34	-15.47	-13.05	21	*0.000
Illinois agility test (Sec)	0.12	1.04	1.55	10.66	21	*0.000

\*SBJ-standing broad jump, VJ- vertical jump

As we can see from the table 4 above, there was a significance improvement on the selected physical fitness of the sampled subjects for the study. As briefly indicated in the table the Std. Error mean, 95% CI difference, t and p-value of all dependent variable numerically in the range of improvement for all sampled subjects.

**Table 5.** Paired sample t-test results on selected Physiological variables of Ambo secondary school male teachers.

Variables	Std. Error mean	95% CI of difference		t	df	P-value
		Lower	Upper			
RHR (bpm)	0.34	5.23	6.67	17.26	21	***0.000
SBP (mmHg)	0.89	6.45	10.18	9.26	21	***0.000
DBP (mmHg)	0.65	3.63	6.36	7.36	21	***0.000
Vo2max (ml/kg/min)	0.33	-8.66	-7.26	-23.74	21	***0.000

RHR-resting heart rate, SBP- systolic blood pressure, DBP- diastolic blood pressure, bpm-beat per mint, mmHg- milliliter mercury, \*\*\*significance level (P<0.001)

The data in the above table (Table 5) reveals that, the paired sample t-test results of the pre- and post-tests of all related physiological variables were significantly improved. As indicated in the table, the std. error mean=0.34, t=17.26 and p-value= 0.000, which is in the range of significance level.

### 3.2. Discussion

Several previous studies and review of articles were strongly agreed with the separate health benefits of aerobic and plyometric exercise participation and their effects on physical fitness and physiological variables of adults. On the other hand the numerous health benefits were followed by aerobic and plyometric exercises involvements like oxygen utilization for energy extracting capacity of our body muscles and short and long term activity working capacity of our boy. The combined effects of these exercises training for health life were not sufficiently studied and need more work in order to create clear awareness regarding the health benefits of these exercises. [14] study on the benefits of aerobic training for improving quality of life, it conclude that routine aerobic exercises can directly reduce stress levels and

increase the quality of life. [13, 26, 27], on the study concurrent training with different aerobic exercises and [28] varied aerobic and plyometric training program were clinically relevant effects on fitness and related physiological variables performance in adolescents and adult teachers. School teachers have the opportunity to utilize the different modes of exercise in their day to day life. The main goal of the workout is to improve the selected physical fitness and related physiological variables, and every school teachers need to choose which modes will suit him the best. As indicated under the results, descriptive statistics of the study, the finding of the present studies indicate the combination of low-to high aerobic and plyometric exercises training induce significant improvements of time duration for completing 30m sprinting speed and Illinois agility test duration from, 6.55sec to 5.63sec, SD= 0.51 with average mean difference of 0.92 and 17.54 to 16.05sec, SD= 0.53 with average mean difference of 1.49sec respectively. On the other the numbers of one minute push up test were improved from 12.36 to 19.13, SD= 1.83 to 2.12 with average mean difference of 6.77 and the distance of SBD and VJ were improved from 1.90 to 2.24m, SD= 0.16 to 0.14, 53.15 to 71.50cm, SD= 14.27 to 12.08 with average mean difference of 0.34m and

18.35cm respectively. All physical fitness tests were significantly improved with the level of significance of ( $P < 0.05$ ). Similarly the related physiological variable of descriptive statistics of the study were RHR improved from, 75.81 to 69.86bpm,  $SD = 4.00$  to  $4.02$  with average mean difference of 5.95bpm, SBP reduced from 131.13 to 122.81mmHg,  $SD = 5.33$  to  $3.98$  with average mean difference of 8.32mmHg, the DBP reduced from 74.09 to 69.09 mmHg, = 3.37 to 6.66 average mean difference of 5.00mmHg finally the maximum oxygen consumption ( $Vo_{2max}$ ) also improved from 29.27 to 37.32ml/kg/min,  $SD = 3.37$  to 2.93 with mean average mean difference of 8.05mmHg. As the results of paired t-test interpretation under the results of the study,

## 4. Conclusion

The result of this study shows that, the aerobic and plyometric exercise can induce significant improvement on physical fitness and related physiological variable performances of teachers of indicated secondary school teachers. As we can see from the results and discussion part of this study, there is statistical difference between the pre-post-test score in all tested variables, so we respect the difference and accept the improvement after treatment administered and recognize the effectiveness of training program. Specifically the results of the descriptive statistics

and paired sample t-test shows that average mean differences on all dependent variable before treatment and after treatment were significantly improved with level of significances of ( $p > 0.005$ ).

## 5. Recommendations

Towards the promotion of longevity and reduce the sedentary life-style of a person, it is therefore, recommended that;

An individual should engage in regular physical activity and reduce sedentary activities to promote health, improve functional capacity and psychological well-being and a healthy body weight and posture, to reduce the risk of chronic diseases in adulthood, engage in at least 60minutes of moderate intensity physical activity above usual activity at work or home on most days of the week. For most people, greater health benefits can be obtained by engaging in combined physical exercise of more rigorous intensity or longer duration. On the bases of the research work findings the researchers of this research work recommended that, teacher should be a role model in leading quality life which is achieved through the participation of regular life activity the core findings of this research work on the other hand father research work will be required using control group incorporating with other variables like diet and probability to have bad habits.

## Appendix

*Table A1. Training protocols/ interventions / for aerobic and plyometric groups for twelve weeks.*

weeks	Aerobic +Plyt Training	Reps	Set	Active Rest b/n set	Intensity	duration
1 <sup>st</sup> -3 <sup>rd</sup> weeks	1) Walking & Jogging 2) Stationary run & Jump 3) Star Jump 4) Rope Jump 5) Box step front jump 6) Plyo push ups 7) Box step side jump	5-6	3	3"	30%-40%	60min. including Warming up and cool down
4 <sup>th</sup> -6 <sup>th</sup> weeks	1) Walking & Jogging 2) Stationary run & Jump 3) Star Jump 4) Tuck jump 5) Plyo push ups 6) Box step side jump	6-7	3	3	50%-70%	60min. including warming up and cool down
7 <sup>th</sup> -9 <sup>th</sup> weeks	1) Classics exercises 2) Jogging and running 3) Stationary run & Jump 4) Star Jump 5) Rope Jump 6) Box step front jump 7) Plyo push ups 8) Burpees	6-8	3	4	50-70	60-90min including warming up and cool down
10 <sup>th</sup> -12 <sup>th</sup> weeks	1) Classics exercises 2) Jogging and running 3) Stationary run & Jump 4) Star Jump 5) Rope Jump 6) Box step front jump 7) Plyo pushups & setups 8) Burpees	6-8	3	4	70-85	60-90min including warming up and cool down

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