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Effects of aerobic exercise on physical performance: A pedagogical and methodological study in the case of Ethiopian middle and long: Distance athletes

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Abstract

Successful performance in aerobic distance running is dependent on the athlete's ability to cover a fixed distance in the shortest time possible. To attain this objective, distance runners must be trained hard, yet intelligent, to maximize the physiological adaptations derived from training (Baechle and Earle, 2000). An effective distance runner's program must include an exercise prescription specifically developed for the individual athlete.

Objective: The objective of this study is, therefore, to see whether aerobic exercise really matters in enhancing athletic performance and, if so, how. Relating to this, the study tried to gauge the impact of different types of aerobic exercises on performance, differentiate between field and treadmill exercises with regard to their impact, determine the whether or not intensity of aerobic exercise matters. As part of doing so, different techniques of measuring performance have been identified and used to determine athletic performance individually, severally and wholly as the case may be. $VO_2\text{Max}$, exercise heart rate, resting heart rate, distances covered are some of the most important ones applied as measures of performance.

Research Design and Methods: Researcher conducted a systematic review of the literature in representative databases for the effect of aerobic exercise training or continuous interval exercise training on Athletes under Ethiopian Olympic Solidarity Gymnasium, Addis Ababa, Ethiopia. The present study, as described earlier, is directed towards gauging how aerobic exercise impacts the performance of athletes. For that end different indicators of performance are seen and examined to identify how they are manipulated in different techniques of aerobic training. Samples of 47 runners (5 females and 42 male Athletes) were from middle and long-distance selected purposively.

Results: The result is that indicated the $VO_2\text{max}$ and heart rate are highly related to athletes' endurance training and it would have its overriding importance in athletics success in the various competitions at local, national and international levels.

Conclusions: This is so much important to bring scientific training into focus for better results in athletics training. Regarding the degree by which subjects have improved their performance, we have no evidence that personal characteristics such as age, gender, and BMI have any kind of relationship. The percentage improvement in their performance is almost similar to people in every BMI, age or gender category. Recommendations the researcher would like to point out that in his data collection effort the main limitation was the lack of direct $VO_2\text{max}$ measurement that would reproduce the sport's specificity with higher accuracy. Therefore, this gadget, which is of high importance for the successful training athletes, those professionals, policy makers and the government, should give much attention for the field so as to improve the prospects of the athletes.

Keywords: $VO_2\text{max}$ ml/kg/min = Maximum Volume of Oxygen Consumption, HRr= Heart Rate at Rest; HER= Exercise Heart Rate; BMI = Body Mass Index and %MHR = Percentage of Maximum Heart Rate

Introduction

Athletic competition represents the classical test of physical fitness or performance capacity. The individual performance is the combined result of the coordinated exertion and integration of a variety of functions. The demands of the actual event must be perfectly matched with the individual's capabilities in order to achieve top performance and championship. In order for exercise physiologists to construct and implement specific training programs, they must have access to the fundamental information concerning the qualities that contribute to successful athletic performance.

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Successful performance in aerobic distance running is dependent on the athlete's ability to cover a fixed distance in the shortest time possible. To attain this objective, distance runners must be trained hard, yet intelligent, to maximize the physiological adaptations derived from training (Baechle and Earle, 2000) [2]. An effective distance runner's program must include an exercise prescription specifically developed for the individual athlete.

In this regard, the regulation of exercise intensity is critical to the success of each training session and ultimately if the entire training program or exercise intensity is set too low, it does not enhance the desired physiological adaptations. On the other hand, if the exercise intensity set too high, it then results in fatigue and a premature end to training sessions.

Laboratory testing is the "gold standard" method for assessing cardiovascular fitness, such as maximal oxygen consumption and lactate threshold estimation, and allows repeatable, reliable, and accurate results to be obtained.

However, this is usually expensive, time consuming, does not allow multiple subjects to be tested at once, and is not specific for athletes competing out of doors. On the other hand, many coaches and exercise prescription specialists use field-tests to evaluate physical fitness. These tests are typically quick, inexpensive, and can be tailored for individual or team needs. Although field-testing is not as accurate as laboratory, testing it can produce estimations of physical fitness parameters. Data from heart rate and $VO_2\text{max}$ using Bruce Protocol Treadmill test, Cooper 12 minute test and Karvanon method of Maximum Heart Rate (MHR) could produce an estimation of physiological predictors of fitness.

Administering and managing reliable test benefits coaches, athletes and sportsmen or women for achieving a successful performance. Adopting testing methods could help to monitor or evaluate sportsmen/women or athletes performance improvement; identify problems and weaknesses. Moreover, it helps coaches to grasp a reliable knowledge to practice their ability with professional capability and confidence.

In Ethiopia there is no scientific observation system developed or adopted. This has motivated the researcher to carry out a research and formulate an observation system that is applicable to middle and long-distance runners in Ethiopia. Although this test is the first of its kind in Ethiopia, it can serve the purpose as a bridge to transfer from the traditional to the scientific. In addition, the results could give an idea of the performance of local athletes and that coaches can devise effective training methodologies and maximize training intensities.

Finally, the other most important background of the present research is that it is believed to be a preliminary work and it could bridge the research gaps or deficiencies of coaches in Ethiopia in order that scientific testing method could be employed by trainers in the days to come.

Statement of the Problem

In designing the training guidelines to be applied to athletes there needs to be a proper understanding as to which kind of aerobic exercise to be administered, and with what degree of intensity. As such, researcher need to distinguish between the salient features of the treadmill training technique as opposed to field aerobic exercise since their effectiveness may depend on the type of the exercise, the background of the subjects as well as the specific dimension of the athletic

performance we sought to bring about. Some research results show $VO_2\text{max}$ is not a predictor of athletes' performance capacity, while some others have supported the belief that $VO_2\text{max}$ is a predictor of performance capacity of athletes.

Bassett *et al.*, (2000) [19] performed maximum oxygen uptake ($VO_2\text{max}$) refers to the highest rate at which oxygen can be taken up and consumed by the body during intense exercise. Traditionally, the magnitude of an individual's $VO_2\text{max}$ has been viewed as one of the most important predictors of endurance performance.

In the earlier research by Bassett *et al* laboratory performance test was used to measure the impact $VO_2\text{Max}$ has on performance. From this point of view, in the present research the researcher examined whether $VO_2\text{max}$ is a predictor for middle and long-distance runners (athletes)/sportsmen/women's performance capacity. This was examined using both field and treadmill test.

Research Questions

1. To what extent treadmill training technique better than the field training technique?
2. How much is the impact of training on the endurance of athletes?
3. Does intensity matter in improving performance?
4. Do Age, gender and body mass index matter on rate of improvement after training?

Objective of the Study

This study was directed towards gauging how aerobic exercise affects the performance of Ethiopian athletes.

Specific Objectives

Specifically, the following objectives were set to be accomplished with this study.

- To assess the degree by which the performance of athletes is affected by aerobic exercise
- To compare between the degree of effectiveness of the treadmill and field aerobic training.
- To see whether or not intensity matters regarding aerobic exercise
- To see whether or not such personality variables as age, gender, BMI matter in the effectiveness of aerobic performance in enhancing the effectiveness of athletes.

Significance of the study

The researcher believes that research has not been done on this topic in Ethiopia. This study showed that the relationship between coaches and athletes determines the effectiveness of the program test to measure the progress of improvement. The study shows the different types of testing and athletes commitment to fitness. Hence, the significant of the study is to show what methods of test work is best and which others do not work at all. As the study shows how coaches use different methods of tests for an effective improvement and workout, it would be a good resource for professionals.

Instructing (coaching) has become more sophisticated as it has required the partial or full assistance of sport specialists. A broader base of knowledge about athletes now exists, which is reflected in training methodology. Sports sciences have progressed from description to scientific.

From practical observation, it could be assumed that training is generally focused on technique and tactic. The training that is aimed at enhancing physical fitness is minimal. The

desirable training that enhances aerobic capacity is even less emphasized, if not totally lacking.

Review of related literatures

Researcher conducted a systematic review of the literature in representative databases for the effect of aerobic exercise training or continuous interval exercise training on Athletes under Ethiopian Olympic Solidarity Gymnasium, Addis Ababa, Ethiopia. This is because it would have a certain effect in the performance capacity of athletes through meticulous training. In relation to this, due emphasis is given in the present research in the way how consistent and effective training would improve the athletes performance. In relation to this, other research works and related review of literature are, indeed, examined and reviewed.

Methodology

Subjects

A total of 47 amateur, well-trained athletes between the ages of 18 and 26 years have served as subjects. Subjects were free of known disease, and all subjects with known disease were be excluded from the study. Individuals with any acute medical conditions, active infection, or taking cardiovascular medications were excluded from the study as well.

The present study, as described earlier, is directed towards gauging how aerobic exercise impacts the performance of athletes. For that end different indicators of performance are seen and examined to identify how they are manipulated in different techniques of aerobic training.

Samples of 47 runners (5 females and 42 male Athletes) were from middle and long-distance selected purposively.

Instruments

As a means of data collection Bruce Treadmill test was used to measure the performance of middle and long distance athletes. This board has shown all the measured variables during the test.

Along with Ken Cooper found in 1968 examined there is a very high correlation between the distance someone can run (or walk) in 12 minutes and their VO_{2max} value, which measure the efficiency with which someone can use oxygen while exercising. This test is still one of the basic fitness tests used by the military, as well as many coaches and trainers to determine cardiovascular fitness and track fitness over time. This simple test also allows comparing athletes' cardiovascular endurance with others of age and gender.

Method of Data Gathering

Data have been gathered using the observation technique where by athletes training in both the field and treadmill were targeted. In this study 47 endurance-trained subjects (mostly runners aged from 18-26 yrs) are involved. Out of these numbers 12 male and 5 female athletes were obtained for treadmill test and 30 male athletes attended field test out of these 13 were control and 17 were experimental groups. Subjects had good health at the time of testing and regularly take part in strenuous exercise. Eligibility had been assessed by subjects undergoing a medical examination that was previously approved by ethical committee of the Ethiopian Ministry of Health.

The Subjects were required to read and sign the enclosed information / consent form. All potential subjects for the

study were recruited from the Ethiopian club, regional and national athletes, Addis Ababa area and were required to complete voluntary written informed consent in accordance with the guidelines of the ethical committee of Ethiopian Ministry of Health.

A series of assessments were carried out. These included: body mass index, height, weight, and pre and post exercise tests. During the first gymnasium visit, a health questionnaire and physical examination was completed, the study and equipment was explained to the subjects, and the subjects VO_{2max} measured.

Method of data analysis

Statistical Analysis

In this part of the study data that have been gathered from the observations and experiments will be explained using different statistical techniques to explain the relationships between the variables under consideration and, thereby, come up with appropriate inference.

Descriptive statistics were performed on the group data using standard statistical procedures. Means and standard deviations were determined for the post-training changes in VO_2 max, The test of the resting heart rate of athletes in the pre- and pos training of the unpaired two-sample t test with equal variant indicate that there is a significant decrease in the resting heart rate after the training sessions.

As part of doing so, different techniques of measuring performance have been identified and used to determine athletic performance individually, severally and wholly as the case may be. VO_{2max} , exercise heart rate, resting heart rate, distance covered are some of the most important ones applied as measures of performance.

With regard to data collection, it has been more of an experimental design than any other by which athletes have been observed with regard to their performance in a before and after fashion focusing on a certain type of exercise, with regard to their performance in a comparative fashion (treadmill and field), and with regard to their performance when they are exposed to different levels of performance to gauge impact of intensity.

The data so collect have been summarized in a quantitative form using the statistical soft ware called Stata. As part of analyzing the data regression (to determine relationships) and the difference between two means (to determine whether there are significant differences among different techniques) have been applied. On top of this, some graphical analyses have also been applied. STATA and SPSS have been applied for the purpose respectively.

Results

The result is that indicated the VO_{2max} and heart rate are highly related to athletes' endurance training and it would have its overriding importance in athletics success in the various competitions at local, national and international levels.

Exercise Heart Rate: Field versus Treadmill

The t test for exercise heart rate in the field versus treadmill of the unpaired two-sample t test with equal variances as there is significant differences between the test results and there is a difference between field and treadmill exercise heart rate.

Exercise Heart Rate: Field Vs Treadmill

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
EHRf	17	160.70	4.083	16.83	152.04 – 169.3
EHRTM	12	186.66	2.623	9.088	180.89 – 192.4
combined	29	171.44	3.541	19.07	164.19 – 178.7
diff		-25.96	5.353		-36.94 – 14.975

diff = mean(ehrf) - mean(ehrTM) t = -4.8490
 Ho: diff = 0 degrees of freedom = 27
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
 Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 1.0000

Source: Computed by Author from Primary data, 2008

Similar to what has been observed in the case of resting heart rate, the field technique of training is again proved to be the more effective technique of training as the exercise heart rate in the case of the said technique is far better than the treadmill technique.

VO₂max: Field Vs Treadmill

The t test VO₂max of the field and treadmill experiment of the unpaired two- sample t test with equal variances show there is a difference between the two methods of training, field and treadmill.

VO₂max: Field Vs Treadmill

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
VO ₂ maxf	17	74.49	.3401	1.4024	73.76 – 75.21
VO ₂ maxTM	12	65.66	.3760	1.3026	64.83 – 66.49
combined	29	70.83	.8580	4.6209	69.08 – 72.59
diff		8.824	.5137		7.769 – 9.87

diff = mean(vo₂maxf) - mean(vo₂maxTM) t = 17.1744
 Ho: diff = 0 degrees of freedom = 27
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
 Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Source: Computed by Author from Primary data, 2008

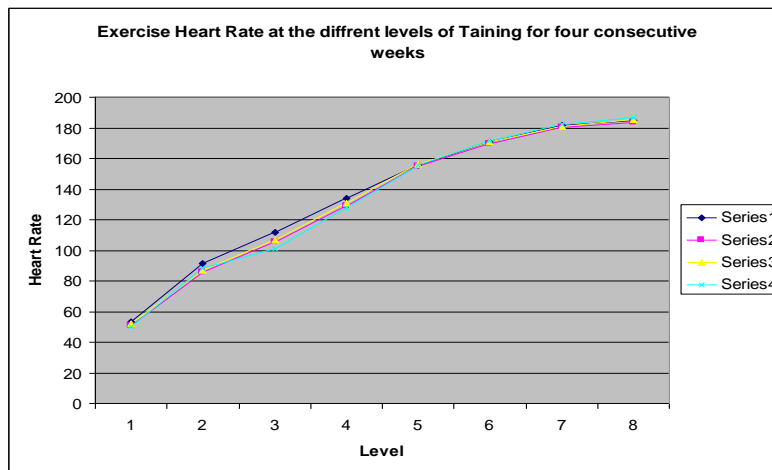
Table above unquestionably asserts that the statistical test for the endurance of athletes to whom the field training technique is applied is perfect to demonstrate that the said athletes perform better than those who were trained using the treadmill technique.

the statistical analysis is shown by computing the statistical data for the samples test of pre and post training Resting Heart Rate (RHR). The graph shows combined result tests of the exercise heart rate at the different level of training. Unpaired t test for Field Test Participants of Pre & Post shows the Heart Rate by monitoring the training intensity.

The Impact of Training on Exercise Heart Rate

The increase in the training intensity implies the drop in the heart rate of endurance training of the athletes. In relation,

The Combined Result of the Four Week Peak Exercise Heart Rate



One approach to prescribe training intensity that has gained widespread appeal is based on a runner's heart rate response to increase running speeds. The training intensity continuum can be divided into discrete zones, where each zone is linked to a particular level or intensity of training. Each training level is defined in terms of the corresponding heart rate range, the specific range for each runner being based on their individual response to incremental exercise.

Conclusion

This is so much important to bring scientific training into focus for better results in athletics training. Regarding the degree by which subjects have improved their performance, we have no evidence that personal characteristics such as age, gender, and BMI have any kind of relationship. The percentage improvement in their performance is almost similar to people in every BMI, age or gender category.

As was clearly seen in the discussion relating to the relevance of training in improving performance of athletes, it is safe to conclude that the treatment (both the field and treadmill training) has a very significant impact for improving the performance of athletes. As can be seen in the pre and post analysis all the measures of performance considered such as VO_{2max} , resting heart rate, exercise heart rate, distance coverage per a unit of time etcetera were significantly improved after training for four weeks.

VO_{2max} or aerobic capacity is measurable responses that indicate the athlete's ability to make physiological adaptations. The exercise training induced physiological adaptations via training are reflected by the above measurements and these can be used to predict the athlete's ability to perform well at these event.

Maximal oxygen consumption has been strongly related with distance running performance and appears to be an increasingly strong indicator of performance with increasing distance run. To conclude, HR monitoring during exercise is essential. It can provide instant response to athlete as an adjective measure. Beside the cardiovascular response at specific training task can also be obtained.

In athletic group, heart rate monitoring can be an important measure to prevent over training. Above all, the use of heart rate monitoring is a good way to establish optimum training intensity to upgrade performance.

The comparison between the treadmill and field training regarding their impact for performance improvement is mixed in the sense that some measures of performance are positively related to the field test whereas the rest positively relate to the treadmill training technique. For example, the treadmill training technique is more effective in improving maximum heart rate and resting heart rate where as exercise heart rate and metabolic improvement are more effectively improved in the field training technique.

Regarding the degree by which subjects have improved their performance, we have no evidence that personal characteristics such as age, gender, and BMI have any kind of relationship. In fact, our findings show that the percentage improvement in their performance is almost similar to people in every BMI, age or gender category.

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Recommendations

Consistent and intensive training are so crucial that athletes need to resort to them relentlessly. In order to secure all rounded improvements in performance people need to apply both treadmill and field training techniques since each of them has their own plus sides. For example maximum heart rate and resting heart rate are effectively improved in the treadmill technique. On the other hand, exercise heart rate and metabolic rate are successfully and easily improved using the field technique.

As part of improving health and developing a good physical stature people need to know that there always is a possibility of improvement regardless of their age, gender or BMI category.

The researcher further suggests that budget accessibility of facilities must be taken a part to take direct VO_{2max} test. Therefore VO_{2max} test is necessarily taking part for the athletes in the laboratory and the athletes also will have basic idea to monitor and measure easily their capacity.

Perhaps this research gives highlight for the coming researcher by undertaking scientific research method. But the study needs laboratory materials and equipments for complete tests of the physiological parameters of sportsmen/women. So that, if all difficulties faced will minimized for the coming researcher will be have good and established fruitful result for the country.

The professionals in the field should work hard in order to apply more scientific ways so as to improve athletes' performances. Then today's top coaches would recognize that the most effective methods of preparing their athletes for competition are those based on proven scientific principles rather than on trial and error.

It has become common place for sport to seek the input of sport scientists so that they can reach their full potential. To reach in this good outlook by this researcher his potential will give some highlight for the coming old and new coaches. Hopefully the methods as well as the test sequence will have very essential element to develop the most effective methods of preparing the athletes for the expected competition with best result.

The field tests showed to be more reliable in relation to the sub-maximal laboratory test, fact that may be attributed to the familiarity and motivation of individuals in places where field tests were usually performed, once, despite not being

athletes, all participants performed regular physical exercises. Therefore, similarity of the test with the activity the athlete practices should be considered in the evaluation moment, once this fact may influence the results obtained.

However, the laboratory test correctly conducted and with the control of the variables involved will also provide reliable results. In this case, the loads will be increasingly administered with accuracy in order to reach the maximum oxygen uptake.

Finally, the main limitation of this study was the lack of direct $\text{VO}_{2\text{max}}$ measurement that would reproduce the sport's specificity with higher accuracy. Therefore, those professionals, policy makers and the government should give much attention for the field so as to increase the contribution of the professionals

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