

# Effect of Hill Running and Circuit Training for Development of Aerobic Fitness among Marathon Runners

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**Abstract.** Marathon is long distance running of 42.195 KM on road. Hill Running and Circuit Training are important training methods to develop Aerobic fitness among Marathon Runners. The Purpose of the study was to find Aerobic Fitness among Marathon Runners of Telangana State in India. Methods: Male Marathon Runners of Telangana State in India who participated in different Marathon events aged 25 to 30 Years were divided into three groups of fifteen each, experimental group of Hill running (n = 15) , Circuit Training group (n = 15) and a control group (n= 15). Both experimental groups trained on alternate days for twelve weeks 1 hour per session and control group underwent general training of Marathon on alternate days. Pre Test and Post Test were conducted among three groups for 12 Min Run Cooper Test to find the maximum distance covered in 12 Min. Results: The results of the study represented by mean and SD showed in pre and post-test a reading of  $2391.83 \pm 102.57$  &  $2678.50 \pm 109.11$  in hill training group with an F ratio of 129.92 at 0.000 level of confidence, whereas circuit training group with mean and SD of  $2365.00 \pm 90.45$  in pre &  $2518.30 \pm 79.78$  in the post with F ratio of 129.92 significant at 0.000 level of confidence indicating that hill training group had noteworthy improvements in performance than circuit training and control groups. Circuit Training group also showed improvements. It is concluded that Hill Running is the good training method to develop the aerobic fitness.

**Key words:** hill running, circuit training, marathon.

**Abstract in Indonesia.** Marathon adalah lari jarak jauh sejauh 42,195 KM on road. Hill Running dan Circuit Training adalah metode pelatihan penting untuk mengembangkan kebugaran aerobik di kalangan pelari maraton. Tujuan dari penelitian ini adalah untuk menemukan Kebugaran Aerobik di antara Pelari Maraton Negara Bagian Telangana di India. Pelari Maraton Pria dari Negara Bagian Telangana di India yang berpartisipasi dalam berbagai acara Maraton berusia 25 hingga 30 Tahun dibagi menjadi tiga kelompok masing-masing lima belas, kelompok eksperimen lari Bukit (n = 15), kelompok Pelatihan Sirkuit (n = 15) dan kelompok kontrol (n = 15). Kedua kelompok eksperimen dilatih pada hari-hari alternatif selama dua belas minggu 1 jam per sesi dan kelompok kontrol menjalani pelatihan umum Marathon pada hari-hari alternatif. Pre Test dan Post Test dilakukan pada tiga kelompok selama 12 menit Run Cooper Test untuk mengetahui jarak maksimum yang ditempuh dalam 12 menit. Hasil: Hasil penelitian yang diwakili oleh mean dan SD menunjukkan pada pre dan post-test pembacaan  $2391,83 \pm 102,57$  &  $2678,50 \pm 109,11$  pada kelompok hill training dengan rasio F 129,92 pada tingkat kepercayaan 0,000, sedangkan kelompok pelatihan sirkuit dengan rata-rata dan SD  $2365,00 \pm 90,45$  di pra &  $2518,30 \pm 79,78$  di pos dengan rasio F 129,92 signifikan pada tingkat kepercayaan 0,000 menunjukkan bahwa kelompok pelatihan bukit memiliki peningkatan kinerja yang patut dicatat daripada pelatihan sirkuit dan kelompok kontrol. Kelompok Pelatihan Sirkuit juga menunjukkan peningkatan. Disimpulkan bahwa Hill Running adalah metode pelatihan yang baik untuk mengembangkan kebugaran aerobik.

**Kata Kunci:** lari bukit, pelatihan sirkuit, maraton.

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## INTRODUCTION

Hill running has a strengthening effect as well as boosting an athlete's power and is ideal for those athletes who depend on high running speeds in games like football, rugby, basketball, cricket players and even runners. To reduce the possibility of injury hill training should be undertaken once the athlete has a good solid base of strength and endurance (Barnes & Kilding, 2015).

Hill training offers the following benefits helps develop power and muscle elasticity, improves stride frequency and length, develops co-ordination, encourages the proper use of arm action during the driving phase and feet in the support phase, develops control and stabilization as well as improved speed

(downhill running), promotes strength endurance, develops maximum speed and strength (short hills) and improves lactate tolerance (Nigatu & Aschenaki, 2017).

Rajesh Kumar (2018) studied about the effect of Hill Training for development of Aerobic fitness among Middle and long distance runners of Hyderabad District in India and concluded that due to Hill Training and Fartlek Training there was a significant development of Aerobic fitness among Experimental Groups.

Circuit is defined as the performance of 6–12 exercises in a sequential order with little to no break between exercises. Circuit training is an exercise "circuit" which consists of prescribed exercises which includes for the upper body, lower back, abdomen and Lower body. It can be done with own body Weight and using the resistance exercises such as Barbells, Medicine Balls etc (Nunez et al, 2018).

Circuit Training results in the calf muscles learning to contract more quickly and thereby generating work at a higher rate, they become more powerful. The calf muscle achieves this by recruiting more muscle fibers, around two or three times as many when compared to running on the flat. The "bouncy" action also improves the power of the quads in the front of the thigh as they provide the high knee lift that is required. For the athlete, when competing in their sport/event, it can mean higher running speeds and shorter foot strike times (Nunez et al, 2020).

Circuit training offers the following benefits helps develop power and muscle elasticity, improves stride frequency and length, develops co-ordination, encouraging the proper use of arm action during the driving phase and feet in the support phase ,develops control and stabilization as well as improved speed (downhill running) and promotes strength endurance (Haff & Triplett 2015; Husnah et al., 2021; Jonathan & Budiharsana, 2021; Maulidya & Ridwan, 2021).

Pradeep Kumar Lenka (2019) in his study the Effect of Resistance Training and Circuit Training on selected Physical and Physiological Variables Among College Male Boxing Players found that that Resistance Training and circuit Training are helpful for development of Physical and Physiological variables among boxers.

Liivia-Mari Lember et al (2020) demonstrated that hill running performance is positively associated with greater aerobic capacity and negatively associated with increases in adiposity and age. Further, the study highlights that hill runners are at risk of negative energy balance.

Schmid et al (2015) in their study on the effect of high-intensity circuit training on physical fitness found that short duration, high intensity circuit training may improve muscle endurance in moderately fit populations. Slight improvements that are gender specific may also be observed in muscle strength as well as aerobic fitness.

The study aimed to find out the Effect of Hill Running and Circuit Training for development of Aerobic Fitness among Marathon Runners of Telangana State in India.

## **METHODS**

Male Marathon Runners of Telangana State in India who participated in different Marathon events in the country between the age group of 25 to 30 Years were equally divided into three groups of fifteen members each the experimental group consisting of Hill running group (n = 15) and Circuit Training group (n = 15) and a control group (n= 15). Hill Running Group and Circuit Training group were given training on alternate days for twelve weeks three times per week and one hour per session and control group has done general training of Marathon for same schedule of timing. The Data were collected in Pre-Test and Post Test for all groups using the 12 Min Run Cooper Test at the start and end of training schedule. The collected data were analyzed statistically by using Mean, SD and ANCOVA. The level of significance was set at 0.05.

### **Training Schedule**

Circuit Training: 8 to 12 Stations exercises in High Knee Running, Bridge, Shuttle Run, Monkey Walk, Sit ups, Pushups, Half Squat jumps, dumbbell exercises etc. on alternate days three times per week and one hour per session. Hill Running: Hill running on short hills, medium hills and long Hills done through continuous method, interval method and repetition method on alternate days three times per week one hour per session.

## RESULTS AND DISCUSSION

**Table 1.** Mean, Standard Deviations, and One-Way Analysis of Covariance (ANCOVA) in Cooper Test 12 Min Run of Hill Running, Circuit Training and Control Group

Test	Hill Running	Circuit Training	Control Group	S O V	Sum of Squares	df	Mean Squares	F-ratio	p-value
Pre test	2391.83	2365.00	2348.33	B	28900.55	2	14450.27		
Mean	102.57	90.45	85.29	W	753390.83	87	8659.66	1.669	.194
SD									
Post test	2678.50	2518.30	2293.33	B	2246274.02	2	1123137.01	129.92*	0.000
Mean	109.11	79.78	87.53	W	752058.46	87	8644.35		
SD									
Adjusted				B	1766839.30	2	883419.65		
Mean	2657.76	2521.29	2311.07	W	162597.46	86	1890.66	467.25*	0.000

Note.\*Significant (P<0.05).

In the above table-1 the Pre Test Mean & SD for 12 Min Run Cooper Test of Hill Running Group was  $2391.83 \pm 102.57$ , Circuit Training  $2365.00 \pm 90.45$  and CG was  $2348.33 \pm 85.29$  and Post Test Mean & SD for 12 Min Run Test of Hill Training Group was  $2678.50 \pm 109.11$ , Circuit Training  $2518.30$  and Control Group  $2518.30 \pm 79.78$  respectively. The Adjusted Mean of Hill Training group was  $2657.76$ , Circuit Training group was  $2521.29$  and control group was  $2311.07$ .

**Table 2.** Comparison of statistical results among all groups of Marathon Runners in 12 Min Run i.e. Cooper Test

Name of the Group	Statistical tool	Cooper 12 min run		
		pre test	post test	M.I
Hill Running Group	Mean	2391.83	2678.5	
	SD	100.85	107.28	11.98
Circuit training group	Mean	2365	2518.3	
	SD	88.94	78.44	6.48
Control group	Mean	2348.33	2293.33	
	SD	883.86	86.07	-2.34

It above table shows the Comparison of statistical results among all groups of Marathon Runners in 12 Min Run i.e. Cooper Test indicating a significant difference between the Hill Running Group than Circuit training Group and Control Group. The result clearly showed that hill training group with MI of 11.98 had noteworthy improvements in performance than the other experimental and control group. Circuit Training group with MI of 6.48 also improved but to a lesser extent than the hill training group. The control group did not show any improvements with MI of -2.34.

Hill running is an endurance sport where intensity and duration are influenced by environmental factors such as terrain and weather and by runners' fitness and nutrition. Endurance athletes such as ultramarathon runners have been observed healthier with lower incidence of injuries and illnesses when compared to the general population (Hoffman and Krishnan, 2014) (Ferbiyana & Sefrina, 2022; Supriyanto, 2022; Widiyatmoko et al., 2022) however, exercising in a mountainous and rocky landscape may increase the risk of falls and injuries as a result of respiratory and locomotor muscle fatigue (Tiller, 2019) highlighting the importance of runners' fitness and nutrition. While the demographics of hill runners are unknown, evidence suggests that running and hill walking are both favored sports among older adults (Ainslie et al., 2002; Stevinson and Hickson, 2014; Lepers and Stapley, 2016). Therefore,

understanding the intensity of hill running and how physiological factors such as body composition and maximal oxygen capacity (VO<sub>2</sub>max) influence hill running performance across different ages can help improve athletic performance and indicate whether hill running promotes healthy ageing. Despite the popularity of hill running there is a dearth of evidence on the improvements in physiological and metabolic implications of participating in this sport. All the above researchers found evidence of improved aerobic fitness through hill training in the athletes which support the results of this study.

Circuit training can incorporate a larger number of individuals' involvement in the same exercise session and in shorter time (Romero et al 2013). CT can either be of moderate intensity or of high intensity. High intensity interval exercise is likely to be a more effective training method than moderate intensity exercise and is used more in building the cardiovascular endurance (Bocalini et al, 2012, Beale et al, 2013). CT that uses endurance exercises is effective in improving cardiopulmonary parameters by working on the maximum oxygen consumption, maximum pulmonary ventilation, functional capacity, myocardial strength, power and endurance thereby improving cardiovascular endurance (Kumar, 2013). Improving the hemodynamic parameters like heart rate, cardiac output and mean arterial pressure leads to an increased cardiorespiratory fitness and building of aerobic capacity (Vilhelmsen et al, 2017).

Uchenwoke, et al (2020) in his research study on circuit training concluded that circuit training has positive effects towards improvement of cardiovascular endurance and maintenance of functional quality of life (QOL). It is therefore necessary for circuit training to be encouraged as a strategy that can be used among young adults. This is in line with the outcome of our study. There are numerous studies which have corroborated with the results of our study on circuit training and these researches of Sobrero et al, 2017, Romero et al, 2013, Mastrangelo et al 2010, Alcaraz et al, 2008 are in line and support it.

## CONCLUSION

It is concluded that Hill Running is a good training method to develop aerobic fitness among Marathon Runners. It is also concluded that Circuit Training is also a good training method to develop aerobic fitness among marathon runners.

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