RESEARCH ARTICLE

Impact of six weeks of athletic training on body composition, physical fitness, and physiological determinants of short-distance runners

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ABSTRACT

Background: The present study has been designed to investigate the effects of six weeks of training on body composition, physical fitness, and physiological determinants of short-distance runners. *Methods:* A total of 75 male volunteers (age: 18–20 years) were included in this study, among them 15 were excluded. The rest 60 volunteers were divided into: (i) the control group (CG, n = 30) and (ii) the experimental group (EG, n = 30). The volunteers of EG underwent a training programme (4 hours/day, 5 days/week, for 6 weeks), and the volunteers of CG were involved in recreational activities. Selected performance determinants were measured at the base line and after six week of study. *Results and Discussion:* A significant increase ($p < 0.05$) in LBM, strength of grip, back, leg, upper body, abdomen muscles, anaerobic power, explosive power of legs, flexibility, VO_{2max}, FEV1, FVC, and PEFR; and a decrease ($p < 0.05$) in body fat percentage, 30 m sprint time, resting blood pressure, heart rate response during exercise and recovery, and peak blood lactate level were noted among the participants of EG following the intervention. The changes observed were due to the effects of training among the sprinters. *Interpretation:* The present study showed that six weeks of training had a significant impact on selected body composition, physical fitness, and physiological variables of the short-distance runners, which are related to their performance. Extensive research is needed on a large sample size as well as long-term training on performance determinants of the short-distance runners.

Keywords: Strength, Power, Speed, Body fat, Training, Sprinters.

Indian Journal of Physiology and Allied Sciences (2024); DOI: 10.55184/ijpas.v76i03.230 **ISSN:** 0367-8350 (Print)

INTRODUCTION

Track and field events are popular in the Olympics, World Championships, and many other prestigious events. The International Association of Athletics Federations (IAAF) set the short-distance running or sprinting into three different distances, viz., 100, 200 and 400 m. The sprint running is covering a distance in the shortest possible duration. The duration of the short-distance running is completed within a very short period of time, e.g., the 100 m run ends within 10 seconds.[1] The unique characteristic of a 100 m sprint is a rapid increase in speed, which requires quick improvement in speed for 60 meters, followed by a maintenance phase for the next 10 to 30 meters, and decelerates in the final 10 to 20 meters.[2]

Short-distance running performance is influenced by body mass, body fat, lean body mass, etc.[3] Performance in the 100 m sprint athletes highly depends on power and technique.[4] Speed and maximum power output have a very strong relationship with sprinting performance.[5] During the event, power output plays an important role as the athlete has to accelerate at a faster rate.[5] Athletes in 100 m running events typically complete the race within 10 seconds, which depends predominantly on the phosphagen system; however, when the distance increases (i.e., during 200 or 400 m), the energy system shifts from the phosphagen system to anaerobic glycolysis.[6] Thus, athletes with higher anaerobic capacity are expected to perform well during the competition. The athlete's capacity to produce more force while running shortsprint depends on strength, power, and speed.[7] The skeletal muscle fibre type is also considered an underlying factor for power generation during short-distance running.[7] In addition, the velocity of movement and sprint-specific endurance also contribute to the success of the athletes.[8] Physiological factors such as heart rate, VO_{2max}, and lung functions also play an important role in the assessment of the health and fitness of the athlete.[2] Training must be designed following the principles of periodization to obtain the highest level of performance.[9] It is important to monitor the training at regular intervals to observe the training adaptation among the athletes.

In recent time's athletes participate in various competitions within a short gap in between and find very little time

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How to cite this article: Ghosh S, Bera S, Ghosh K, Singha P, Jana A, Manna I. Impact of six weeks of athletic training on body composition, physical fitness, and physiological determinants of short-distance runners. *Indian J Physiol Allied Sci* 2024;76(3):34-41.

Conflict of interest: None

Submitted: 02/05/2024 **Accepted:** 18/09/2024 **Published:** 30/09/2024

for physical conditioning in between the competitions. It is essential to monitor the physical and physiological adaptation to training among the athletes before the competition. Short-term high-intensity training has been proposed as an effective training method to achieve metabolic conditioning and improve anaerobic and aerobic fitness.[1,2] Short-term training may be helpful to the sprinters, which can induce physiological adaptations and improve performance. Little information is available on the impact of short-term training on sprint performance. The present study aimed to investigate the effects of a short-term high-intensity training program on body composition, physical fitness, and physiological determinants of state-level sprinters.

MATERIAL AND METHODS

Participants

This study was carried out by the Department of Physiology, Midnapore College (Autonomous), under the Midnapore College Research Centre (Science), affiliated to Vidyasagar University, West Bengal, India. A total of 75 male volunteers (age: 18–20 years) were included in this study following medical examinations by the physicians from Midnapore district, West Bengal, India. Among them, forty were short-distance runners who participated in state-level competitions, and 35 were sedentary control. Ten short-distance runners and five sedentary control volunteers with a history of chronic illness, fracture, and surgery for at least 3 months prior to the commencement of the study were excluded; the remaining 60 volunteers were grouped as: (i) the control group (CG, n = 30) and (ii) the experimental group (EG, n = 30). The sample size was determined by G*Power software following the standard method.[10] According to the software, a minimum of 54 volunteers was required. In the present study, 60 volunteers were included to avoid the mid-study dropout.

Experimental Design

All the volunteers acclimatized with the protocol for 15 days prior to the study. The volunteers of the experimental group (EG) followed a training schedule (4 hours/day, 5 days/week, for 6 weeks), whereas the volunteers of the control group (CG) were engaged in recreational activities. The volunteers of the experimental group were asked to stay away from strenuous physical activity other than the prescribed training programme. All volunteers were asked to maintain their normal traditional diet and stay away from fast food and carbonated cold drinks. Body composition, physical fitness, and physiological variables were assessed at the beginning (0 week) and after 6 weeks of study (Figure 1).

Ethical Considerations

The purpose and possible complications of the study were explained to all participants, and written consent was obtained. The Institutional Ethical Committee (Human Studies), Midnapore College (Autonomous) approved this

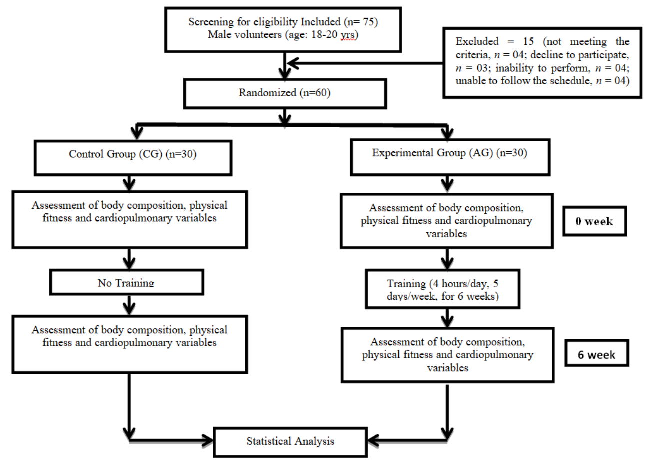

Figure 1: The experimental design

study. The Institutional Ethical Committee (Human Studies), Midnapore College (Autonomous) approved this study [No. MC/IEC (HS)/PHY/Ph.D.RF/02/2023; Date: 19.08.2023].

Training

The volunteers of the experimental group followed a training schedule (4 hours/day, 5 days/week, for 6 weeks) under the guidance of a well-trained coach following a standard protocol.[9] Training were given according to the principle of periodization. The 6 week training program was divided into phases: (i) general preparation (1–3 weeks, for preparation of physical fitness); and (ii) specific preparation (4–6 weeks, for technical and tactical skills development). The volume and intensity of each training session varied during these phases. In each week, 5 days of training were given in two sessions, morning and evening. In each session, 2 hours of training were given, which began with warm-up exercise and ended with cool-down exercise. In morning sessions, strength training, weight training, speed endurance, bounding and hoping, stretching, active recovery, plyometrics, flexibility, mobility, and agility exercises were given. On the other hand, in the evening sessions, speed workouts, sprinting workouts, stretching exercises, flexibility exercises, endurance runs, and hurdle drills were given. To reduce the effects of over training, one day of recreational activity and one day of complete recovery were suggested (Tables 1 and 2).

Procedures

Measurement of body composition

The height and body mass of the participants were measured using standard procedures.[11] Skin fold thickness was measured by a skin fold calliper (Cescorf, USA) from biceps, triceps, sub-scapular, and suprailiac skin fold sites for the determination of body fat following standard procedure.[12] Lean body mass (LBM) was determined from a standard equation.[11,12] Waist and hip circumference were recorded with a non-stretchable tape, and the values were used for determination of waist-hip ratio.[11]

Table 1: Six weeks training plan for short distance runners

Phases			6 weeks training plan		
Phases of training			Baseline	General preparation (Physical Preparation)	Specific preparation (Technical and tactical Preparation)
Sub-phases			Zero level baseline		
Periodization		Strength	-	Anatomical adaptation	Maximal Strength
Endurance		-	Aerobic	Anaerobic	
Speed		-	Specific high		
Skills		-	Foundation	Advanced	
Macro Cycles			0 weeks	1–3 weeks	4–6 weeks
Training Factors	Volume	100%	-	80–90%	70%
	Intensity	90%	-	70–80%	80%
	Peaking	80%	-	70–75%	80%
	Physical Preparation	70%	-	50–55%	40–45 %
	Technical Preparation	60%	-	40–45%	40–45%
	Tactical Preparation	50%	-	10%	10%
	Psychological Preparation	40%	-	10%	10%

Table 2: Details of training administered in a week for short distance runners

Day	*Morning (2 hours)*	*Evening (2 hours)*
Monday	Warm up Strength training: Lower body exercises, core exercises Cool down	Warm up Sprint workout 60 m x 5 x 2 Set 100 m x 4 x 2 Set 60–70% 200 m x 3 x 2 Set Cool down
Tuesday	Warm up Weight training 40–60% Bounding & hoping Static stretching Cool down	Warm up Sprinting work out 30 m x 6 x 2 set 40 m x 4 x 2 set Static stretching exs. Cool down
Wednesday	Recovery and mobility: Active recovery, mobility exercises	Foam rolling and self-myofascial release, flexibility training, core exercises, recreational activity
Thursday	Warm up Weight training 40–50% (Circuit Training) Plyometrics, bounding and hopping Cool down	Warm up Endurance run: 30-40 minutes at moderate pace Cool down
Friday	Warm up Flexibility/mobility/agility exercises. Easy stretching Cool down	Warm up Sprint workout 100 m/ 400 m x 2x2 set 200 m/ 400 m x 2 x 2 set 400 m x 2 x1 set Cool down
Saturday	Warm up Speed endurance: 8-10 x 200/400 m sprints Stretching exercises Cool down	Warm up Hurdle drills, stretching Core stability Tapering: Reduce the volume and intensity. Cool down
Sunday	Rest and recovery	Rest and recovery

Measurements of physical fitness variables

Strength of the hand grip muscles of the volunteers was measured by a grip dynamometer (Baseline, USA), whereas back and leg muscle strength was measured by a back and leg dynamometer (Baseline, USA) using standard procedure.[11] Upper body strength was evaluated by push-up test, and abdominal muscle strength was evaluated by sit-up test.[11] Leg muscle power was determined by vertical jump test.[11] Explosive power of the legs was assessed by standing board jump test.[11] The maximum power and anaerobic capacity of the volunteers were determined by the running-based anaerobic sprint test (RAST) following the standard method.[13] The speed of the athlete was determined by a thirty-meter running test.[11] Flexibility of the participant was assessed by sit-and-reach test.[11]

Measurements of physiological variables

The volunteer was asked to take rest in a sitting position for fifteen minutes. Resting heart rate (HR_{rest}) and blood pressure were measured by using an electronic sphygmomanometer (Omron, Japan) following the standard method.[14] Volunteers were asked to run on the treadmill at 6 and 8 km/hr for 2 minutes at each speed for determination of sub-maximal exercise heart rate. Volunteers were then asked to run on the treadmill at 12 km/hr until volitional exhaustion, and the maximum heart rate (HR_{max}) and recovery heart rate (HR_{rec}) were recorded by Polar H10 Heart rate monitor (Polar, USA).[15] Maximum aerobic capacity (VO_{2max}) of the volunteer was measured by the yo-yo intermittent recovery Test 1 (YYR1) following standard method.[16] Lung function tests, including FVC, FEV1, and PEFR, were measured by a digital spirometer (Micro I Spirometer, Care Fusion, Japan).[17] Blood lactate level was measured at rest and after maximum exercise by a portable blood lactate analyzer (Lactate Scout 4, EKF Diagnostics, USA).[18]

Data Analysis

Descriptive statistics including mean and standard deviation were computed. A paired sample t-test was performed to compare the variables measured at the beginning (0 week) and after 6 weeks of study. To find out the relationship between the variables correlation coefficient was performed. The alpha was considered at 0.05.[19] Computerized software package SSPSS-20 for Windows (IBM, USA) was used for statistical analysis.

RESULTS

Impact of Athletic Training on Body Composition Variables of Short Distance Runners

A significant decrease ($p < 0.05$) in percent body fat and an increase ($p < 0.05$) in LBM were noted among the volunteers of the experimental group after six weeks of athletic training programme. The volunteers of the experimental group also showed reduced ($p < 0.05$) percent body fat than the volunteers of the control group (Table 3).

Impact of Athletic Training on Physical Fitness Variables of Short Distance Runners

The results showed a significant increase ($p < 0.05$) in the strength of grip, back, leg, upper body, abdomen, leg muscle power, explosive power of legs, maximum power output, anaerobic capacity, and flexibility; a decrease ($p < 0.05$) in 30 meter sprint time among the volunteers of the experimental group after six weeks of athletic training programme. The volunteers of the experimental group had higher ($p < 0.05$) strength, power, and flexibility and a lower ($p < 0.05$) 30 meter sprint time than the control group volunteers (Table 4).

Impact of Athletic Training on Physiological Variables of Short Distance Runners

This study showed a significant increase ($p < 0.05$) in VO_{2max}, FEV1, FVC, and PEFR and a decrease ($p < 0.05$) in resting systolic and diastolic blood pressure, resting heart rate, sub-maximum exercise heart rate, maximum heart rate, 1st minute recovery heart rates, and peak blood lactate level among the volunteers of the experimental group after six weeks of athletic training programme. No significant

Table 3: Impact of training on body composition variables of short distance runners

Parameter	*Control Group (CG)*		*Experimental Group (EG)*	
	0 week	*6 week*	*0 week*	*6 week*
Height (cm)	168.2 ± 5.6	168.7 ± 5.5	169.2 ± 6.7	169.6 ^{NS} ± 6.6
Weight (kg)	60.8 ± 5.5	60.5 ± 5.4	59.5 ± 6.5	59.7 ^{NS} ± 5.5
BMI (kg/m^2)	21.5 ± 1.5	21.3 ± 1.4	20.8 ± 1.4	20.8 ^{NS} ± 1.2
BSA (m^2)	1.7 ± 0.1	1.7 ± 0.1	1.7 ± 0.1	1.7 ^{NS} ± 0.1
Body fat (%)	12.9 ± 1.5	13.0 ± 1.6	13.0 ± 1.5	11.9*# ± 1.6
Fat mass (kg)	8.5 ± 1.6	7.9 ± 1.6	7.8 ± 1.6	7.1^{NS} ± 1.5
LBM (kg)	50.5 ± 3.5	52.3 ± 3.6	50.2 ± 4.3	52.6* ± 4.3
Waist-hip ratio	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.8^{NS} ± 0.1

All the data were expressed as mean ± SD; n=30, paired sample t-test was performed; when compared to '0 week' and '6 weeks- *$p<0.05$; when compared to CG and EG- #$p<0.05$; SD= standard deviation, BMI= Body mass index, BSA= Body surface area, LBM= lean body mass, WHR- Waist Hip ratio. NS= Not significant.

Table 4: Impact of training on physical fitness of short distance runners

Parameter	*Control group (CG)*		*Experimental group (EG)*	
	0 week	*6 week*	*0 week*	*6 week*
GSTR (kg)	34.5 ± 3.6	34.7 ± 3.6	34.9 ± 3.8	36.9*# ± 3.4
GSTL (kg)	32.7 ± 3.2	31.7 ± 3.4	33.5 ± 3.2	35.3*# ± 3.3
Back strength (kg)	114.5 ± 6.1	117.1 ± 5.9	117.3 ± 9.4	122.3*# ± 9.5
Leg strength (kg)	120.8 ± 8.3	124.3 ± 8.5	124.3 ± 10.3	130.4*# ± 10.1
Push up (no/min)	29.1 ± 5.9	31.1 ± 4.0	30.7 ± 6.1	34.4*# ± 5.3
Sit up (no/min)	30.8 ± 4.5	31.4 ± 4.6	30.9 ± 3.7	34.2*# ± 3.4
Standing broad jump (m)	2.8 ± 0.3	2.8 ± 0.4	2.8 ± 0.4	3.1*# ± 0.3
Vertical Jump (m)	0.5 ± 0.06	0.57 ± 0.09	0.6 ± 0.07	0.7*# ± 0.08
30 m sprint (sec)	4.3 ± 0.2	4.3 ± 0.2	4.3 ± 0.1	4.2*# ± 0.1
HPO (watt)	813.0 ± 64.9	817.4 ± 67.5	796.8 ± 64.6	854.3*# ± 62.2
LPO (watt)	421.3 ± 58.3	413.5 ± 61.3	435.2 ± 63.5	471.3*# ± 67.2
APO (watt)	11.2 ± 2.8	11.5 ± 2.6	10.3 ± 2.8	10.9^{NS} ± 2.7
AC (watt)	3762.4 ± 324.5	3709.4 ±312.6	3551.7 ± 329.2	3812.6* ± 338.1
Fatigue index (watt/sec)	11.2 ± 2.8	11.5 ± 2.6	10.3 ± 2.8	10.9^{NS} ± 2.7
Flexibility (cm)	32.8 ± 4.6	34.1 ± 4.7	33.6 ± 6.1	37.5*# ± 6.0

All the data were expressed as mean ± SD; n=30, paired sample t-test was performed; when compared to '0 week' and '6 weeks- *p<0.05; when compared to CG and EG- #p<0.05; SD= standard deviation, GSTRH = grip strength of right hand, GSTLH = grip strength of left hand, HPO = highest power output, LPO = lowest power output, APO = average power output, AC = anaerobic capacity. NS= Not significant.

change was noted in resting blood lactate level, 2nd and 3rd minute recovery heart rates among the volunteers of the experimental group after six weeks of training programme. In addition, the volunteers of the experimental group showed higher ($p < 0.05$) VO_{2max} and PEFR; and lower ($p < 0.05$) resting systolic blood pressure and sub- maximal exercise heart rate than the control group volunteers (Table 5).

DISCUSSION

The present investigation showed that six weeks of training programme significantly increased LBM, strength of grip, back, leg, upper body, abdomen, leg muscle power, explosive power of legs, maximum power output, anaerobic capacity, flexibility, VO_{2max}, FEV1, FVC, and PEFR; and reduced percent body fat, 30 m sprint time, resting systolic and diastolic blood pressure, resting heart rate, sub-maximal exercise heart rate, maximum heart rate, 1st minute recovery heart rates, and peak blood lactate level among the volunteers of the experimental group. The volunteers of the experimental group had greater strength, power, flexibility, VO_{2max} and PEFR, and reduced percent body fat, 30 m sprint time, resting systolic blood pressure and sub-maximal exercise heart rate than the control group volunteers after six weeks of study.

The height, body mass, body fat, lean body mass, and circumferences are often used for predictions of the body composition of the athletes.[20] These variables are associated with the performance of the running athletes.[20, 21] This study showed a decrease in percent body fat and an increase in lean body mass (LBM) among the volunteers of the experimental group after six weeks of athletic training programme. It has also been noted that the volunteers of the experimental group had a lower percent body fat than the control group volunteers. These changes might be due to training among the experimental group volunteers. On the other hand, the control group volunteers did not receive any training, and therefore they had a higher percent body fat than the experimental group volunteers. It has been reported that short-term sports training may reduce percent body fat in athletes.[21, 22] Body fat plays a crucial role in running athletes, as excess body fat increases the body mass of the athlete and may cause difficulty in performing skilful activities during the athletic events.

The sprint running events like 100 m require quick improvement in speed, but during the long sprint running events such as 200 and 400 m, the starting is a little slow.[2] In 100 m sprint speed is continuously accelerated till 40 to 60 m, which is followed by a maintenance phase for the next 10 to 30 m, and then the athletes decelerate in the final 10 to 20 m.[2] Performance in short-distance running depends on several factors such as speed, strength, power, technique, sprint-specific stamina, etc.[5,6] It has been reported that there is a strong relationship between speed and power output; the closer these two variables are related, the shorter the sprint distance.[7,8] Therefore, speed, strength, and power

Table 5: Effects of training on physiological variables of short distance runners

Parameters	*Control group (CG)*		*Experimental group (EG)*	
	0 week	*6 week*	*0 week*	*6 week*
SBP (mmHg)	118.7 ± 5.4	118.5 ± 5.2	116.1 ± 8.4	113.2*# ± 7.5
DBP (mmHg)	72.6 ± 6.2	69.5 ± 6.1	71.0 ± 5.8	66.4* ± 5.8
HR_{rest} (bpm)	67.2 ± 3.1	68.2 ± 3.5	65.6 ± 3.9	65.9* ± 3.7
$HR_{submax1}$ (bpm)	130.9 ± 3.9	129.7 ± 4.0	130.4 ± 3.6	127.2*# ± 3.9
$HR_{submax2}$ (bpm)	146.4 ± 4.0	145.8 ± 5.6	145.9 ± 3.8	143.8* ± 3.6
HR_{max} (bpm)	197.0 ± 4.5	197.2 ± 4.6	196.4 ± 5.2	193.5* ± 5.3
HR_{rec1} (bpm)	165.2 ± 4.5	165.4 ± 4.8	167.8 ± 4.3	161.4* ± 4.4
HR_{rec2} (bpm)	137.4± 3.8	137.7 ± 4.3	136.8 ± 4.1	131.3^{NS} ± 4.5
HR_{rec3} (bpm)	108.5 ± 4.8	108.2 ± 4.2	108.7 ± 4.7	106.6^{NS} ± 4.3
VO_{2max} (mL/kg/min)	45.7 ± 3.6	45.6 ± 4.3	47.8 ± 5.9	51.3*# ± 5.7
FEV1 (lit)	3.7 ± 0.3	3.8 ± 0.4	3.8 ± 0.3	4.0*± 0.3
FVC (lit)	3.8 ± 0.3	3.9 ± 0.3	3.9 ± 0.3	4.0*± 0.3
FEV1/FVC	98.7± 1.2	98.5 ± 1.6	98.5 ± 1.3	97.8^{NS} ± 1.5
PEFR	440.1 ± 28.6	454.6 ± 29.3	452.7 ± 36.2	480.2*# ± 38.2
BL_{rest} (mmol/l)	2.4 ± 1.0	2.5 ± 1.0	2.3 ± 1.1	2.2^{NS} ± 1.0
BL_{peak} (mmol/l)	18.2 ± 3.2	17.3 ± 3.3	18.7 ± 2.6	15.9* ± 2.5

All the data were expressed as mean ± SD; n=30, paired sample t-test was performed; when compared to '0 week' and '6 weeks- *p<0.05; when compared to CG and EG- #p<0.05; SD= standard deviation, SBP = systolic blood pressure, DBP = diastolic blood pressure, HR_{rest}= resting heart rate, $HR_{submax1}$= sub maximal heart rate 1st load, $HR_{submax2}$= sub maximal heart rate 2nd load, HR_{max}= maximum heart rate, HR_{rec1}= recovery heart rate in 1st min, HR_{rec2}= recovery heart rate in 2nd min, HR_{rec3}= recovery heart rate in 3rd min, VO_{2max}= maximum aerobic capacity, FEV1= force expiratory volume in 1st sec, FVC= force vital capacity, PEFR = peak expiratory flow rate. BL_{rest} = resting blood lactate, BL_{peak} = peak blood lactate. NS= Not significant.

variables are associated with the performance of short-distance running athletes.[7,8] In this study, an improvement in strength, power, and flexibility and a reduction in sprint time were observed among the volunteers of the experimental group after 6 weeks of an athletic training programme. These changes might be due to the effects of athletic training among the experimental group volunteers. In addition, the volunteers of the experimental group showed higher strength, power, and flexibility and a shorter sprint time than the control group volunteers. As the control group, volunteers did not receive any training, so lower strength, power, and flexibility were noted, and longer sprint times were noted among them. It can be stated that power training might improve the anaerobic energy system, which might be responsible for the improvement of the power of the athletes. An increase in the strength of the back and leg muscles might help to improve the sprint performance of the athlete. In addition, an increase in flexibility might help the athlete to improve skills related to sprint performance. Success in sprint running events is dependent on strength, power, speed, flexibility, and techniques that help the runner maintain a rapid velocity during a race. Similar studies reported that resistance and weight training improved muscular strength and sprint development.[7,8,23] It has been reported that short-term sports training may be effective to improve physical fitness determinants such as strength, power, speed, and flexibility in athletes.

In international competitions, the 100 m sprint is ideally finished within 10 seconds, which depends on the anaerobic metabolism of the phosphagen system (ATP-PCr), which provides ATP required for muscle contraction. However, as the distance increases (in the case of 200, 400 m), the energy system shifts to anaerobic glycolysis.[6,16] The physiological variables, including heart rate, blood pressure, maximum aerobic capacity (VO_{2max}), lung functions, and blood lactate, may limit the performance of short-distance runners.[1,2] These factors may underlie the sprinting speed of the athletes. This study showed an increase in VO_{2max}, FEV1, FVC, and PEFR and a decrease in resting systolic and diastolic blood pressure, resting heart rate, sub-maximal exercise heart rate, maximum heart rate, 1st minute recovery heart rates, and peak blood lactate level after 6 weeks of athletic training programme among the volunteers of the experimental group. These changes might be due to the effects of the athletic training programme among the volunteers of the experimental group. The participants of the experimental group showed increased VO_{2max} and PEFR and decreased resting systolic blood pressure and sub-maximal exercise heart rate than that the control group. As the control group, volunteers did not receive any training, so lower VO_{2max} and PEFR and higher resting systolic blood pressure and sub-maximal exercise heart rate were noted among them. Similar studies had reported that training has a significant role in the improvement in VO_{2max} and pulmonary functions of athletes.[25,26] The increase in VO_{2max} might be due to an increase in cardiac output, increased oxygen delivery to the exercising muscle, and increased utilization of oxygen for aerobic metabolism.[15, 25] Regular exercises might increase the strength of the respiratory muscles, thus making them more efficient in the uptake of air in the lungs; this might be the reason that the FEV1, FVC, and PEFR increased after training.[15,26] The faster recovery helps the athletes perform repeated activities. The main reason for the decrease in heart rate after training might be parasympathetic activation.[15]

The present study showed that six weeks of training had a significant impact on selected body composition, physical fitness, and physiological variables of the short-distance runners. Regular monitoring of these variables plays a role in the evaluation of the performance of the short-distance runners. The investigation was performed on a small sample size (30 volunteers) in each group for a short period of time (six weeks). It is essential to study the long-term training adaptation on body composition, physical fitness, and physiological variables of sprint-running athletes on a large sample. As there is scanty research on sprinters in India, therefore, extensive research is needed to observe the effects of long-term training on performance determinants of the short-distance runners.

ACKNOWLEDGMENT

The authors sincerely acknowledge the contribution of the volunteers, students, coaches, and laboratory staff for this study.

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PEER-REVIEWED CERTIFICATION

During the review of this manuscript, a double-blind peer-review policy has been followed. The author(s) of this manuscript received review comments from a minimum of two peer-reviewers. Author(s) submitted revised manuscript as per the comments of the assigned reviewers. On the basis of revision(s) done by the author(s) and compliance to the Reviewers' comments on the manuscript, Editor(s) has approved the revised manuscript for final publication.