

# EFFECT OF BALANCE TRAINING ON THE PHYSICAL FITNESS OF MARATHON RUNNERS



ORIGINAL ARTICLE  
ARTIGO ORIGINAL  
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EFEITO DO TREINAMENTO DE EQUILÍBRIO SOBRE A APTIDÃO FÍSICA DOS MARATONISTAS

EFFECTO DEL ENTRENAMIENTO DEL EQUILIBRIO EN LA APTITUD FÍSICA DE CORREDORES DE MARATÓN

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## ABSTRACT

**Introduction:** As a comprehensive sport, Marathon presents high demands concerning the athletes' comprehensive capacity. **Objective:** This paper explores to what extent balance skill training can effectively contribute to improving physical fitness for marathon runners. **Methods:** 120 marathon runners were selected for the pilot experiment. The experimental group received balance training, while the control group underwent no intervention. **Results:** In the experimental group, the time with eyes closed and feet apart increased from  $33.559 \pm 15.8570$  to  $37.203 \pm 15.5865$ s, the time spent in the T-shaped run from  $10.144 \pm 0.5063$ s to  $9.908 \pm 0.5225$ s, the time spent in the standing long jump from  $2.831 \pm 0.2648$ m to  $3.058 \pm 0.3183$ m, and the time spent in the T-shaped run from  $55.544 \pm 2.2581$  to  $60.845 \pm 2.4367$  times/min. The total FMS score changed from  $14.618 \pm 0.9392$  to  $18.481 \pm 1.3909$ . Shoulder flexibility increased from  $2.777 \pm 0.4756$  to  $2.917 \pm 0.2994$ , and active straight knee raise changed from  $2.306 \pm 0.4692$  to  $2.803 \pm 0.403$ . **Conclusion:** Daily balance training can be added to usual marathon training to improve the fitness of its athletes. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Postural Balance; Physical Education and Training; Physical Fitness; Marathon Running.

## RESUMO

**Introdução:** A maratona, enquanto esporte integral, apresenta altas exigências relativas à capacidade plena dos atletas. **Objetivo:** Este artigo tenta explorar em que medida o treinamento da habilidade de equilíbrio pode efetivamente contribuir para o aprimoramento da aptidão física aos praticantes do esporte de corrida de maratona. **Métodos:** 120 corredores de maratona foram selecionados para o experimento piloto. O grupo experimental recebeu treinamento de equilíbrio, enquanto o grupo de controle não sofreu qualquer intervenção. **Resultados:** No grupo experimental, o tempo com olhos fechados e pés separados aumentou de  $33,559 \pm 15,8570$  para  $37,203 \pm 15,5865$ s, o tempo gasto na corrida em forma de T de  $10,144 \pm 0,5063$ s para  $9,908 \pm 0,5225$ s, o tempo gasto no salto em pé em distância de  $2,831 \pm 0,2648$ m para  $3,058 \pm 0,3183$ m, e o tempo gasto na corrida em forma de T de  $55,544 \pm 2,2581$  para  $60,845 \pm 2,4367$  vezes/min. A pontuação total de FMS mudou de  $14,618 \pm 0,9392$  para  $18,481 \pm 1,3909$ . A flexibilidade do ombro aumentou de  $2,777 \pm 0,4756$  para  $2,917 \pm 0,2994$ , e o levantamento reto do joelho ativo mudou de  $2,306 \pm 0,4692$  para  $2,803 \pm 0,403$ . **Conclusão:** O treinamento de equilíbrio diário pode ser adicionado ao treino de maratona habitual para melhorar a aptidão física de seus atletas. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Equilíbrio Postural; Educação Física e Treinamento; Aptidão Física; Corrida de Maratona.

## RESUMEN

**Introducción:** El maratón, como deporte integral, presenta grandes exigencias en cuanto a la capacidad integral de los atletas. **Objetivo:** Este trabajo pretende explorar hasta qué punto el entrenamiento de las habilidades de equilibrio puede contribuir eficazmente a la mejora de la condición física de los corredores de maratón. **Métodos:** Se seleccionaron 120 corredores de maratón para el experimento piloto. El grupo experimental recibió entrenamiento de equilibrio, mientras que el grupo de control no se sometió a ninguna intervención. **Resultados:** En el grupo experimental, el tiempo con los ojos cerrados y los pies separados aumentó de  $33,559 \pm 15,8570$  a  $37,203 \pm 15,5865$ s, el tiempo empleado en la carrera en forma de T de  $10,144 \pm 0,5063$ s a  $9,908 \pm 0,5225$ s, el tiempo empleado en el salto de longitud de pie de  $2,831 \pm 0,2648$ m a  $3,058 \pm 0,3183$ m, y el tiempo empleado en la carrera en forma de T de  $55,544 \pm 2,2581$  a  $60,845 \pm 2,4367$  veces/min. La puntuación total de FMS pasó de  $14,618 \pm 0,9392$  a  $18,481 \pm 1,3909$ . La flexibilidad de los hombros aumentó de  $2,777 \pm 0,4756$  a  $2,917 \pm 0,2994$ , y la elevación activa de la rodilla pasó de  $2,306 \pm 0,4692$  a  $2,803 \pm 0,403$ . **Conclusión:** El entrenamiento diario del equilibrio puede añadirse al entrenamiento habitual de maratón para mejorar la forma física de sus atletas. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptor:** Equilíbrio Postural; Educação y Entrenamiento Físico; Aptitud Física; Carrera de Maratón.



## INTRODUCTION

Nowadays, with the gradual rise of “marathon fever”, more and more people have participated in the marathon race. Sports marathon usually allows participants in good physical condition to participate in, so as to ensure good physical fitness, which can meet the requirements of participating in the marathon race.<sup>1</sup> This sport is the only track and field competitive event, and both men and women can participate in and fully integrate into the ranks of national fitness. At the same time, marathon has many characteristics, such as long distance, high intensity and relatively high risk. Generally speaking, natural ease is the main tone of the project.<sup>2</sup> The skill of marathon is that the step length needs to be appropriate and the pace should be faster, which will reduce energy consumption. The most critical stage is when the foot lands. The lower leg should be in a vertical state during the foot landing stage. Generally, the sole or outside of the foot lands first, and then the whole foot lands;<sup>3</sup> The landing process should not generate force, and the projection line of the body center of gravity should be used as the reference standard of the landing site. Balance training ability can play an effective role in activating nerves and controlling muscles.<sup>4</sup>

The nervous system of the human body continuously receives signals from the visual center, organ vestibule, muscle, joint capsule and proprioceptors in the skin, and achieves the goal of regulating body balance by activating and controlling muscles, so as to keep the limbs stable.<sup>5</sup> The quality of balance ability is an important factor for the human body to maintain balance and stability when completing sports, and the lack of balance ability is the main cause of sports injuries in sports. Balance ability has a positive effect on the overall ability of marathon runners,<sup>6</sup> How to improve the overall ability of marathon runners through balance training; Which programs can effectively improve the runner’s balance ability; Based on the above questions, this paper analyzes the relationship between marathon training and balance ability through experimental research.<sup>7</sup> Marathon is a high-intensity sports event, which requires a high level of cardiopulmonary function. The main purpose of this study is to study the application of balance training in marathon competition.<sup>8</sup>

## METHOD

### Research object

In this paper, 120 professional marathon runners were selected as the experimental subjects, and there was no significant difference in the physical indicators of the selected experimental subjects. The study and all the participants were reviewed and approved by Ethics Committee of Education Bureau of Guanyun County (NO.EBGCF006). The average age of the subjects was 20-21 years old, the height was about 1.78m, and the average weight was 64kg. The 120 marathoners were randomly divided into the experimental group and the control group for eight weeks of intervention training. The experimental group received eight weeks of balance training. The control group did not receive any balance training, but only daily training. During the 8-week experiment, 120 marathoners kept a normal diet. The specific conditions of the experimental objects are shown in Table 1.

### Experimental methods

In this 8-week experiment, different training forms are adopted for marathon runners in the control group and the experimental group. Before training, 60 marathon runners in each group should be numbered,

**Table 1.** Two groups of marathoners.

Option	Control group	Experience group	P
Age	20.302 ±1.3237	21.110 ±0.5393	0.5640
Height (m)	1.803 ±0.0917	1.755 ±0.0796	0.3126
Weight (kg)	66.132 ±10.4596	62.700 ±9.2686	0.7918
Physical test results	83.396 ±7.8985	80.231 ±5.7158	0.3446

and the training sequence of marathon runners should be arranged according to their numbers. 60 marathon runners in the experimental group should be trained for two weeks on the balance ability of primary intensity, Then carry out 4 weeks of intermediate strength balance training, and finally carry out 2 weeks of advanced strength balance training. The 60 marathoners in the control group did not take any intervention and only took normal marathon training during the 8-week experiment.

## RESULTS

### Effect of balance ability training on balance ability of marathon runners

Table 2 shows the changes of balance ability of marathon runners after 8 weeks of experiment.

According to the P value<0.05, there is a significant difference between the experimental group and the control group in terms of closed eyes and single feet, and there is no significant difference in terms of T-running. At the same time, there are significant differences between the experimental group and the control group in standing long jump and sit ups. It shows that the balance ability training can improve the balance ability of marathon runners mainly in the aspects of closed eyes, standing long jump and sit ups, but not in the aspect of T-running.

The change rate of sit ups in the control group was the largest, 9.9924%, followed by the closed eyes and single feet in the experimental group, 9.7960%. However, only the T-shaped running change rate of the experimental group showed a negative value, indicating that after the balance ability training, the T-shaped running time of marathon runners would decrease, while the T-shaped running time of marathon runners without balance ability training would increase. After the balance ability training, the marathon runners’ ability to close their eyes on one foot, standing long jump and sit up has been significantly improved, which is obviously better than the control group in these three aspects.

### Effect of balance ability training on improving the metabolic level of marathon runners

Table 3 shows the changes of metabolic level of marathon runners after 8 weeks of experiment.

There is a significant difference between the experimental group and the control group in terms of stable heart rate during exercise and recovery of heart rate after exercise, while there is no significant difference between the control group in terms of maximum oxygen uptake and strength endurance. At the same time, the experimental group had significant differences in the maximum oxygen uptake and strength

**Table 2.** The Effect of Balance Training on the Balance Ability of Marathoners.

Group		Before experiment	After experiment	P	Rate of change
Closed eye monopod (s)	Experience group	33.559 ±15.8570	37.203 ±15.5865	0.0122	9.7960%
	Control group	30.785 ±16.6794	32.265 ±16.3975	0.0305	4.5870%
T-run (s)	Experience group	10.144 ±0.5063	9.908 ±0.5225	0.0570	-2.3886%
	Control group	10.116 ±0.5616	10.198 ±0.5593	0.0547	0.8049%
Standing long jump (m)	Experience group	2.831 ±0.2648	3.058 ±0.3183	0.0459	7.4247%
	Control group	2.852 ±0.3517	2.905 ±0.2697	0.0447	1.8323%
Sit ups (times/min)	Experience group	55.544 ±2.2581	60.845 ±2.4367	0.0132	8.7129%
	Control group	54.583 ±2.6567	60.643 ±2.9275	0.0381	9.9924%

**Table 3.** The Effect of Balance Training on the Metabolic Level of Marathoners.

Group		Before experiment	After experiment	P	Rate of change
Maximum oxygen uptake (ml/kg/min)	Experience group	51.706±2.4904	55.439±2.7301	0.0162	6.7325%
	Control group	52.214±2.4370	52.855±2.4545	0.0488	1.2124%
Stable heart rate during exercise (times/min)	Experience group	174.051±12.8464	164.957±13.0017	0.0031	-5.5134%
	Control group	170.200±12.8956	169.806±12.9440	0.0358	-0.2322%
Heart rate recovery after exercise (s)	Experience group	233.099±13.3726	215.314±13.0215	0.0120	-8.2597%
	Control group	230.515±12.5898	219.695±13.5833	0.0335	-4.9251%
Strength endurance (W)	Experience group	229.258±16.7817	248.334±15.4727	0.0152	7.6815%
	Control group	228.449±14.5820	239.820±15.4504	0.0471	4.7417%

tolerance. It shows that balance training can significantly improve the metabolic level of marathon runners.

The change rate of heart rate recovery after exercise in the experimental group was the most obvious, which was -8.2597%, followed by the strength endurance of the experimental group, which was 7.6815%. After the balance ability training, the marathon runners' heart rate will recover after the exercise and the running time and the stable heart rate during the exercise will decrease. After the balance ability training, the metabolic level of the marathon runners will be significantly improved, which should be significantly better than the control group.

### Effect of balance ability training on comprehensive ability of marathon runners

Table 4 shows the changes of FMS comprehensive ability of 60 marathoners in the control group after the 8-week experiment.

Marathoners in the control group only had significant differences in the total FMS score, straight lunge, and trunk stability push up, while the rest had no significant differences. At the same time, the change rate of trunk stability push up is the most obvious, and the change rate of shoulder flexibility is the least. During normal marathon training, the stability of the athlete's trunk will be significantly improved in push up, straight lunge, hurdle stance and rotation. However, it will also lead to decreased shoulder flexibility and active straight knee lifting.

Table 5 shows the changes of FMS comprehensive ability of 60 marathon runners in the experimental group after 8 weeks of experiment.

Marathoners in the experimental group had significant changes in all aspects of the total FMS score. The change rate of shoulder flexibility is the smallest, and the change rate of rotation stability is the largest. It is worth mentioning that after the balance ability training, the athlete's shoulder flexibility, active knee lifting and other aspects will be improved, which is beyond the ordinary marathon training.

## DISCUSSION

In order to avoid the injury of marathon athletes in sports, we need to clearly recognize that balance ability training is a relatively scientific training method, which can reduce sports injury to a certain extent. However, the ability of balance training is not perfect. After all, marathon sports have certain requirements for physical fitness. If there is pain or injury, you need to go to the hospital in time to find a professional sports rehabilitation personnel for careful treatment. It is necessary to train the balance ability according to the actual situation. You can't trust the balance ability training. Therefore, under the guidance of professionals

**Table 4.** Effect of Control Training on Improving the Comprehensive Ability of Marathoners' FMS.

Option	Before experiment	After experiment	P	Rate of change
Total FMS score	15.231±2.0848	17.364±1.4941	0.0010	12.2851%
Squat	2.006±0.6023	2.068±0.6803	0.3446	3.0175%
Hurdle step	2.033±0.4229	2.413±0.5165	0.0550	15.7508%
Straight Lunge	2.234±0.4533	2.763±0.4514	0.0259	19.1590%
Shoulder flexibility	2.631±0.5235	2.590±0.5113	0.3466	-1.5665%
Active straight knee lifting	2.452±0.5165	2.403±0.6672	0.3507	-2.0105%
Torso stability push up	2.176±0.8296	2.830±0.3901	0.0396	23.0846%
Rotational stability	1.823±0.3885	2.030±0.1321	0.1665	10.1563%

**Table 5.** The Effect of Balance Training on the Comprehensive Ability of Marathoners' FMS.

Option	Before experiment	After experiment	P	Rate of change
Total FMS score	14.618±0.9392	18.481±1.3909	0.0136	20.9008%
Squat	1.732±0.4664	2.436±0.5316	0.0112	28.9162%
Hurdle step	1.940±0.2988	2.542±0.5245	0.0134	23.6752%
Straight Lunge	1.986±0.1203	2.740±0.4664	0.1661	27.5352%
Shoulder flexibility	2.777±0.4756	2.917±0.2994	0.0250	4.7880%
Active straight knee lifting	2.306±0.4692	2.803±0.4035	0.0539	17.7545%
Torso stability push up	2.191±0.4019	2.633±0.5054	0.0834	16.7640%
Rotational stability	1.311±0.4035	2.121±0.3060	0.0145	38.1807%

and in combination with your own situation, it is necessary to develop personal training methods to improve your physical fitness.

Balance plays a leading role in all components of sports, whether in strength, speed, flexibility and endurance. The central nervous system, sensory vestibule, somatosensory system and human body system determine the ability of self balance. The nervous system constantly receives signals from vision, muscle, organ vestibule, joint capsule and proprioceptive organs in the skin, maintains body balance by awakening and controlling the stability of limbs, and provides guarantee for completing various difficult movements.

It can be seen that the sensory balance ability of the human body is the comprehensive embodiment of the functions of the nervous system and the motor system. In sports, no matter what kind of sports, athletes must rely on vestibular function. Good vestibular function is a prerequisite to ensure athletes to complete high-quality sports. Scientific and systematic training can improve the ability of athletes to maintain stability in different conditions and different spaces, which also improves the stability of the body. Especially in many competitive sports, athletes need a high degree of physical stability when jumping and landing. Therefore, strengthening the balance ability in training to maintain the stability of athletes in the marathon race plays an important role in the marathon race. Balance ability is the basis to ensure that the human body can complete all kinds of sports in the state of exercise. Especially in the marathon race, it requires highly coordinated and vigorous exercise. The importance of balance ability is increasingly obvious. Nowadays, more and more experts from different fields participate in the research on balance seeking ability, but the research content is biased greatly, and gradually involves in the training of marathon.

Nowadays, almost most sports events need good body balance ability, and athletes need good balance and sense of balance to achieve good performance in sports events. Similarly, in the marathon race, through balance training, the economic level of marathon athletes has made significant progress. In training, the body sometimes loses balance. Once the body loses balance, it needs more balance training to increase the balance of the body. By practicing balance ability, you

can improve your weak point of poor balance ability and also reduce the damage to the body. Planned and purposeful balance training is helpful for muscle and nerve memory. If you want to achieve good results in the marathon, you need athletes to train regularly. By using the motor nervous system, athletes can give positive feedback to information and achieve the goal of body balance.

## CONCLUSION

According to the experimental results of this paper, we can draw the following conclusions: (1) Balance ability training can significantly improve the comprehensive ability of marathon runners, especially in the use of time

with eyes closed and one foot, the effect is most significant. (2) Balance ability training can significantly improve the metabolic level of marathon runners, especially the time of heart rate recovery after exercise is the most significant. After eight weeks of balance ability training, the time of heart rate recovery of marathon runners after exercise is significantly reduced. (3) Balance ability training can achieve the effect that ordinary marathon training can not achieve, that is, it can significantly improve the shoulder flexibility of marathon runners, and actively lift the knee.

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All authors declare no potential conflict of interest related to this article

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**AUTHORS' CONTRIBUTIONS:** The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Jingjing Ren and Weijuan Yao: writing and execution.

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