Training characteristics of US Olympic Marathon Trials qualifiers

© by IAAF
23:2; 31-37, 2008

By Jason R. Karp

ABSTRACT

Researchers have attempted to link differences in distance running performance with physiological measurements but few have focused on the training characteristics of elite distance runners. This study describes and compares training characteristics of male and female qualifiers for the 2004 USA Olympic Marathon Trials. Ninety-three athletes (56 men, 37 women) responded to a questionnaire that covered 1) physical characteristics and performance, 2) training history, 3) financial support, 4) training volume, 5) training intensity, 6) strength training and 7) altitude training. Marathon time was correlated to performance in other running events for both sexes, and to number of years training, average and peak weekly training distance, number of weekly runs, and number of runs > 32 km for women. Although data from other countries is sparse, the author suggests that elite American marathoners train less at higher intensities than their foreign counterparts. He also notes that many train without a coach and suggests this is an area where improvement might be found.

AUTHOR

Jason R. Karp, PhD, is a coach, fitness consultant, freelance writer and competitive runner. His writing has appeared in numerous international running, coaching, and fitness magazines and scientific journals. He currently coaches athletes of all levels through his website RunCoachJason.com.

Introduction

One day, while at the track with one of my athletes who was training to qualify for the 2004 USA Olympic Marathon Trials, I began to wonder how other runners who had already qualified train. Was their programme similar to what I was having my athlete do? How many kilometres per week were they running? How much of their training volume was run at specific intensities? Did they do strength training? Unfortunately, there is little research on the long-term training of distance runners, leaving much unknown about training for endurance performance. Most of the information on the training of runners is found in books and magazines. So with the Trials right around the corner, I decided to take a scientific approach in order to find answers to the above questions.

Two hundred and fifty-five athletes (104 men, 151 women) qualified for the 2004 USA Olympic Marathon Trials by running 2:22:00 or faster (men) and 2:48:00 or faster (women) within two years of the event. They were all given a questionnaire asking about their physical characteristics, training history, financial support, personal records for various dis-

Table 1: Average physical and performance characteristics of US Olympic Marathon trials qualifiers

	Total		Men		Women	
	Men	Women	Elite (<2:15)	National-Class (2:15-2:22)	Elite (<2:40)	National-Class (2:40-2:48)
Age (years)	30.1	31.9	31.1	30.0	31.3	32.1
Height (cm)	177.8*	163.8	172.7	178.6	163.8	163.8
Weight (kg)	65.1*	51.1	59.4	66.0	51.0	51.2
BMI (kg/m2)	20.6*	19.1	19.9	20.7	19.0	19.1
Marathon PB	2:19:03*	2:42:45	2:12:03**	2:20:08	2:33:54***	2:44:54
5km PB	14:27*	17:02	13:44**	14:34	16:16***	17:13
10km PB	30:00*	35:13	28:25**	30:17	33:37***	35:37
1/2-Marathon PB	1:06:23*	1:17:33	1:03:29**	1:06:48	1:14:04***	1:18:31

PB=personal best. *Statistically different from women. **Statistically different from national-class men. ***Statistically different from national-class women.

tances, and training characteristics. All questions pertained to the entire year preceding the 2004 Olympic Trials. Ninety-three athletes (36.5%) responded to the questionnaire (37 men and 56 women) and were divided into two categories—elite (sub 2:15 for men, sub 2:40 for women) and national-class (2:15-2:22 for men, 2:40-2:48 for women).

Physical Characteristics and Performance

Olympic Marathon Trials qualifiers weigh less and have a lower body mass index (BMI) than the general population. A low body weight increases running economy (the amount of oxygen used at a given speed) and body temperature regulation and decreases shock upon landing[1]. Within this homogeneous group of runners, however, there was no relationship between marathon performance and age, height, weight, and BMI, as the elite runners had similar physical characteristics to the national-class runners (Table 1).

As expected, marathon performance was significantly correlated to performance for 5,000m, 10,000m, and half-marathon. Since races lasting longer than three minutes depend primarily on aerobic metabolism, it's no surprise that those who are fastest at 5,000m and 10,000m are also fastest in the marathon. It is no coincidence that all six athletes who made the USA Olympic marathon team were very successful on the track at shorter distances before moving up to the marathon.

Training History

An interesting finding of this study is the number of Trials qualifiers who either did not have a coach or trained alone during the year preceding the Trials. Only 51 percent of men and 69 percent of women trained with a coach and 65 percent of men and 68 percent of women trained alone. Combining these two conditions, 46 percent of men and 29 percent of women trained alone and without a coach!

It is unheard of for Olympic Trials-caliber athletes in other individual sports, such as swimming, speed skating, gymnastics and cycling, to train by themselves and without a coach. While the lack of equipment or facilities needed makes it easier for runners to train in solitude, the above numbers beg the question as to whether there is a need to organise coached training groups for marathoners who exhibit potential.

Table 2: Average general training characteristics of US Olympic Marathon Trials qualifiers

	Total		Men		Women	
	Men	Women	Elite	National-Class	Elite	National-Class
Years training	12.2* (3-21)	8.8 (1-24)	16.8 (12-20)	11.4 (3-21)	12.3*** (6-20)	8.0 (1-24)
Avg. weekly distance (km)	145.3* (55-125)	116.0 (40-120)	155.6 (90-100)	144.2 (55-125)	135.8*** (60-120)	111.3 (40-100)
Peak weekly distance (km)	192.9* (80-154)	152.2 (65-143)	203.2 (99-140)	191.8 (80-154)	180.0*** (80-143)	145.8 (65-120)
Longest run (km)	40.2 (20-52)	37.8 (18-30)	36.5 (20-24)	40.7 (20-52)	38.1 (18-26)	37.8 (20-30)
Number of runs > 32 km	17.7* (1-60)	10.4 (0-50)	7.7 (1-12)	18.7 (2-60)	11.9 (0-50)	10.0 (1-40)
Number of weekly runs:						
1st quarter	8.1*	6.1	12.5**	7.8	8.9***	5.5
2nd quarter	8.6*	7.1	13.0	8.3	10.1**	6.4
3rd quarter	9.3*	7.2	12.5	9.1	9.3***	6.7
4th quarter	8.7	8.0	11.0	8.6	10.5***	7.3

*Statistically different from women. **Statistically different from national-class men. ***Statistically different from national-class women. Range of values in parentheses. Number of weekly runs are divided into quarters of the year, with the 4th quarter being the last 3 months before the Olympic Trials.

Financial Support

Sixty-two percent of men (elite: 0%; national-class: 72%) and 57 percent of women (elite: 45%; national-class: 60%) had a full-time job as their primary source of income. Given that the national-class runners were significantly more likely to have a full-time job than the elite runners, the obvious question is, "Does having a full-time job prevent a runner from becoming elite?" While not working full-time certainly allows more time for training, only the elite women ran more kilometres in training than the national-class women; the elite and national-class men ran similar volumes.

Training Volume

Despite their relative homogeneity in performance and their elite status among the nation's marathoners, the Olympic Marathon Trials qualifiers trained very differently from one another, as there was great variability in the data. While the different responses suggest that there may be many paths to success, it may also be an indication that these runners, especially those who train alone and/or without a coach, are not optimising their training.

For the year preceding the Olympic Trials, the male marathoners averaged 145 km per week with a peak of 193, while the female marathoners averaged 116 km per week with a peak of 152. The men also ran more times per week and did more long runs (> 32 km) than did women (Table 2).

Although women have been running marathons in the Olympics for more than two decades, there may still be a lingering belief that women are at a greater risk of injury than men and therefore should not run as much as men. However, research suggests that female runners do not have a greater susceptibility to stress fractures than their male coun-

Table 3 – Amount of training at different intensities of US Olympic Marathon trials qualifiers and selected foreign runners

	U.S. Total		U.S. Men		U.S. Women		
	Men	Women	Elite	National-Class	Elite	National-Class	Male Elite
% training distance @ MP	9.7	12.8	7.5	9.9	12.1	13.0	3.9
% training distance @ LT pace	10.3	12.3	12.6	10.0	10.2	12.8	8.7
% training distance > 10km pace	5.2	6.5	4.0	5.2	7.0	6.4	5.9
% training distance > 5km pace	3.0	4.8	1.0	3.1	5.5	4.7	—

MP = marathon pace; LT=lactate threshold; "> denotes "at or faster than."

terparts as long as they don't exhibit characteristics of the female athlete triad (amenorrhea, disordered eating, and osteoporosis)[12].

Another potential reason why the men ran more than the women is that the men's Olympic Marathon Trials qualifying standard is more difficult to obtain than the women's qualifying standard. While the men's standard (2:22) was 13.6 percent (17 minutes) slower than the men's world record (2:04:55), the women's standard (2:48) was 24 percent (32.5 minutes) slower than the women's world record (2:15:25). Simply put, in order to qualify for the Olympic Trials, men had to attain a better performance than did women. The more difficult men's standard is likely due to their greater depth of competition. While 99 men ran within 13.6 percent of the world record, only 9 women ran within that same percentage of the world record. Time to train, coaches' prescriptions, and prior training experience may have also caused differences in training volume between sexes.

Among these runners, the amount of training has a greater influence on women's marathon performance than it does on men's, as a number of training characteristics were statistically different only between elite and national-class women and statistically correlated only to women's marathon performance, likely due to their greater range of performances. Elite women trained for more years, ran more kilometres, and ran more times per week compared to their national-class counterparts (Table 2). Moreover, women's marathon performance was correlated to each of these training characteristics. Of these, the number of weekly runs explained the greatest amount of variance (41%) in women's marathon performance. Thus, the better female marathoners (but not the better male marathoners) simply run more.

One of the criticisms of American distance runners is that they don't run enough or as much as their predecessors of the 1970s and 1980s. From the little scientific documentation available, it seems that the marathoners who qualified for the 2004 Olympic Trials do run as much as their predecessors, as Pollock[15] reported that elite male American marathoners of the 1970s ran 162.0km per week, while SPARLING et al.[16] reported that elite female American long-distance runners of the 1980s ran 120.4km per week. However, today's American marathoners run less than their foreign counterparts. BILLAT et al.[4] reported that male French and Portuguese elite and high-level runners ran 206 and 168km per week, respectively, and female elite and high-level runners ran and 166 and 150km per week, respectively. BILLAT et al.[5] reported that male Kenyan runners who did low and high amounts of speed training ran 174 and 158km per week, respectively, and female runners who did a high amount of high-intensity training ran 127km per week.

French & Portuguese (From BILLAT et al.[4])			Kenyan (From BILLAT et al.[5])		
Male High-Level	Female Elite	Female High-Level	Male High-Speed Training	Male Low-Speed Training	Female High-Speed Training
4.2	7.3	6.0	—	—	—
7.5	6.8	5.5	6.8	14.6	0
6.3	8.9	8.3	9.2	2.2	11.7
—	—	—	—	—	—

Although anecdotal accounts of athletes' training found in books likely represent embellishments of peak training and therefore must be taken with a grain of salt, it appears that today's American runners run considerably less weekly distance than runners of the past. In one of the most comprehensive of these books[13], sample training weeks from elite marathoners show that Frank Shorter (USA), Olympic marathon gold (1972) and silver (1976) medallist, ran about 185km per week, Derek Clayton (AUS), former marathon world record holder, ran about 240km per week, and Grete Waitz (NOR), nine-time winner of the New York City Marathon and Olympic marathon silver medallist, ran about 160km per week.

Training Intensity

The majority of the runners' training was at a low intensity. Men ran 74.8 percent (elite: 75.9%; national-class: 74.9%) and women ran 68.4 percent (elite: 70.7%; national-class: 67.8%) of their weekly training distance slower than marathon pace. Distance runners traditionally perform most of their training at intensities well below race pace, at what has been called long, slow distance (LSD) running. The popularity of LSD training may stem from the practices of Arthur Lydiard of New Zealand, the first running coach to detail separate base and peaking training phases and was arguably the most influential coach in the history of distance running. While running at a low intensity induces the many adaptations associated with endurance performance (e.g., mitochondrial proliferation, capillarisation, and increases in aerobic enzyme activity), it has not been scientifically tested whether performing the majority of training at a low intensity, at the expense of more race-specific training, is the most effective way to train.

Although it makes practical sense to train at race pace, this was not the strategy of the Trials qualifiers. Men averaged only 9.7 percent (elite: 7.5%; national-class: 9.9%) and women averaged 12.8 percent (elite: 12.1%; national-class: 13.0%) of their yearly training at marathon pace. In addition, despite the importance of the lactate threshold to distance running performance and the closeness of its corresponding speed to marathon race pace, men averaged only 10.3 percent (elite: 12.6%; national-class: 10.0%) and women averaged 12.3 percent (elite: 10.2%; national-class: 12.8%) of their yearly training at lactate threshold (tempo) pace. Despite the relatively low amount of race pace training, U.S. marathoners run more of their weekly training distance at marathon pace and lactate threshold (tempo) pace than do foreign distance runners (Table 3). Both men and women increased the amount of training performed at marathon pace and tempo pace throughout the year, as time got closer to the Trials.

The marathoners did very little interval training to prepare for the Trials, averaging only one interval workout a week throughout the year. Men averaged 5.2 percent (elite: 4.0%; national-class: 5.2%) and 3.0 percent (elite: 1.0%; national-class: 3.1%) of their yearly training at or faster than 10km and 5km race pace, respectively. Women averaged 6.5 percent (elite: 7.0%; national-class: 6.4%) and 4.8 percent (elite: 5.5%; national-class: 4.7%) of their yearly training at or faster than 10km and 5km race pace, respectively. None of these values were statistically different between the sexes or between performance levels.

It appears that American marathoners run slightly less at high intensities than their foreign counterparts (Table 3). While it is difficult to claim that the success of foreign athletes, specifically the Kenyans, is a result of their high percentage of training at high intensities, it is possible that training at high intensities contributes to their performances. COETZER et al.[7] found that elite black South African runners, who trained at a higher average intensity than their white counterparts, were able to sustain a higher percentage of their VO_2max during races longer than 5,000m. The black runners also had a statistically lower blood lactate concentration after submaximal and maximal exercise and took a statistically longer time to fatigue during repetitive quadriceps isometric contractions. While a high weekly training volume at submaximal intensities improves endurance performance by increasing capillary and mitochondrial volumes, training at a high intensity is more effective for increasing VO_2max[2]. Further improvements in endurance performance have been shown to occur by adding interval training to elite distance runners' training programmes[3].

Strength Training

Collectively, the runners studied included little strength training in their training programmes. During the year preceding the Trials, the men averaged less than one and the women averaged less than two strength training workouts per week. About half of the runners did not do any strength training at all and some only strength trained during periods of the year when they were injured and could not run. So, either the nation's elite marathoners either do not believe that strength training will make them better marathoners, or they did not have the time to strength train given the time they devote to running.

Whether strength training is beneficial for distance running performance is questionable. Strength training may lead to improved endurance performance in previously untrained subjects[11], while more experienced, highly-trained athletes may not benefit from traditional strength training[8] and may even be hampered by it, especially if it is performed at the expense of more specific training[9]. Some research has shown that explosive strength training[10,14] and plyometric training[17,19] improve running economy and endurance performance by increasing muscle power production.

Altitude

Unlike East African distance runners, whose altitude training has become legendary through the popular media, only 24 percent of male and 16 percent of female Trials qualifiers trained at altitude, and did so only because they already lived there. The success of the Kenyan and Ethiopian distance runners notwithstanding, there is little scientific evidence that training at altitude is better than training at sea-level for improvements in VO_2max or sea-level performance[6,20]. There is some evidence that living at altitude and training at sea-level (the so-called "live high/train low" model) may improve sea-level performance[18] by inducing the red blood cell production associated with altitude exposure while maintaining sea-level training intensity. Interestingly, most of the best American distance runners have historically been born and trained at sea-level. If altitude were the "secret to success," one would expect a disproportionate number of elite American. distance runners to live at altitude. Although American distance runners train less at altitude than the East Africans, it is unlikely that this is the reason for their apparent inferiority.

Conclusion

Beyond running at a pace slower than race pace, there is no consensus among Olympic Marathon Trials qualifiersas to how to prepare for the marathon. Between performance levels, the characteristics of training influence women's marathon performance more so than men's. Although data on the training characteristics of foreign distance runners is sparse, it seems that U.S. marathoners train less at higher intensities than their foreign counterparts.

Please send all correspondence to:
Dr Jason Karp
Jason@runcoachjason.com

REFERENCES

1. BERG, K. (2003). Endurance training and performance in runners: research limitations and unanswered questions. Sports Medicine. 33:59-73.

2. BILLAT, V.L. (2001). Interval training for performance: A scientific and empirical practice. Sports Medicine. 31:13-31, 2001.

3. BILLAT, V.; BEMARLE, A.; PAIVA, M. & KORALSZTEIN, J-P. (2002). Effect of training on the physiological factors of performance in elite marathon runners (males and females). International Journal of Sports Medicine. 23:336-341.

4. BILLAT, V.L.; BEMARLE, A.; SLAWINSKI, J.; PAIVA, M. & KORALSZTEIN, J-P. (2001). Physical and training characteristics of top-class marathon runners. Medicine and Science in Sports and Exercise. 33:2089-2097

5. BILLAT, V.L.; LEPRETRE, P.M.; HEUGAS, A.M.; LAURENCE, M.H.; SALIM, D. & KORALSZTEIN, J-P. (2003). Training and bioenergetic characteristics in elite male and female Kenyan runners. Medicine and Science in Sports and Exercise. 35:297-304.

6. CHAPMAN, R.F. & LEVINE, B.D. (2000). The effects of hypo- and hyperbaria on performance. In: Garrett, W.E.; Kirkendall, D.T. (eds). Exercise and Sport Science. Philadelphia: Lippincott Williams & Wilkins, pp. 452-453.

7. COETZER, P.; NOAKES, T.D.; SANDERS, B.; LAMBERT, M.I.; BOSCH, A.N.; WIGGINS, T. & Dennis, S.C. (1993). Superior fatigue resistance of elite black South African distance runners. Journal of Applied Physiology. 75:1822-1827.

8. HELGERUD J. (1994). Maximal oxygen uptake, anaerobic threshold and running economy in women and men with similar performances level in marathons. European Journal of Applied Physiology and Occupational Physiology. 68:155-161.

9. HOFF, J.; HELGERUD, J. & WISLØFF, U. (2002). Endurance training into the next millennium: muscular strength training on aerobic endurance performance. American Journal of Medicine and Sports. 4:58-67.

10. HOFF, J.; HELGERUD, J. & WISLØFF, U. (1999). Maximal strength training improves work economy in trained female cross-country skiers. Medicine and Science in Sports and Exercise. 31:870-877.

11. MARCINIK, E.J.; POTTS, J.; SCHLABACH, G.; WILL, S.; DAWSON, P. & HURLEY, B.F. (1991). Effects of strength training on lactate threshold and endurance performance. Medicine and Science in Sports and Exercise. 23:739-743.

12. NATTIV, A. (2000). Stress fractures and bone health in track and field athletes. Journal of Science and Medicine in Sport. 3:268-79.

13. NOAKES, T.D. (2003). Lore of Running. Champaign, IL: Human Kinetics.

14. PAAVOLAINEN, L.; HAKKINEN, K.; HAMALAINEN, I.; NUMMELA, A. & RUSKO, H. (1999). Explosive-strength training improves 5-km running time by improving running economy and muscle power. Journal of Applied Physiology. 86:1527-1533.

15. POLLOCK, M.L. (1977). Characteristics of elite class distance runners—overview. Annals of the New York Academy of Sciences. 301:278-282.

16. SPARLING, P.B., WILSON, G.E. & PATE, R.R. (1987). Project overview and description of performance, training, and physical characteristics in elite women distance runners. International Journal of Sports Medicine. 8:73-76.

17. SPURRS, R.W.; MURPHY, A.J.; WATSFORD, M.L. (2003). The effect of plyometric training on distance running performance. European Journal of Applied Physiology. 89:1-7.

18. STRAY-GUNDERSEN, J.; CHAPMAN, R.F. & LEVINE, B.D. (2001). "Living high-training low" altitude training improves sea-level performance in male and female elite runners. Journal of Applied Physiology. 91:1113-1120.

19. TURNER, A.M.; OWINGS, M. & SCHWANE, J.A. (2003). Improvement in running economy after 6 weeks of plyometric training. Journal of Strength and Conditioning Research. 17:60-67.

20. WILBER, R.L. (2001). Current trends in altitude training. Sports Medicine. 31:249-265.