Open Access Journal of Sports Medicine

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ORIGINAL RESEARCH

Post-marathon wearing of Masai Barefoot Technology shoes facilitates recovery from race-induced fatigue: an evaluation utilizing a visual analog scale

This article was published in the following Dove Press journal:
Open Access Journal of Sports Medicine
8 December 2014
Number of times this article has been viewed

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Purpose: To investigate the potential benefit of post-race wearing of unstable shoes (Masai Barefoot Technology [MBT]) on recovery from marathon race–induced fatigue.

Patients and methods: Forty-five runners who participated in a full marathon race were divided into three groups: 1) MBT shoes, 2) trail running shoes, and 3) control (CON). Participants ran a full marathon with their own running shoes, and then put on the assigned shoes immediately after the race. They continued to wear the assigned shoes for the ensuing 3 days. The CON group wore their usual shoes. Estimates of post-race fatigue were made by the participants on questionnaires that utilized a visual analog scale. Estimates were made just after the race, as well as for the next 3 days.

Results: The subjective fatigue of the MBT group was lower than that of the CON ($P<0.05$) or trail running shoe groups ($P<0.05$) on day 3.

Conclusion: MBT shoe intervention can promote recovery from the fatigue induced by running a full marathon.

Keywords: footwear, VAS, full marathon

Introduction

Long-distance running has recently become popular all over the world, and a large number of people participate in full marathons and even longer races.[1,2] Completing a full marathon gives rise to profound muscle fatigue.[3] Post-race fatigue can be disruptive to both work efficiency and overall quality of life.[3] A fast recovery from post-race fatigue also enables athletes to stay in good condition for training and performance. Therefore, there is a large demand for an effective, simple method for optimizing recovery from the exhaustive fatigue that follows the completion of a full marathon.

In this study, we focus on the footwear worn by runners in their everyday life, following severe exercise. We particularly evaluated the shoes produced by Masai Barefoot Technology (MBT; MBT USA, Inc., St Louis, MO, USA). These shoes were developed as a training aid that was said to produce a positive effect during standing or walking while wearing the shoes.[4] The shoes were developed about 20 years ago, utilizing the concept that a benefit could be derived by causing the wearer to increase their range of motion (ROM) and to control the instability produced by a rounded sole. The producers claim that the MBT shoes: 1) improve balance ability, 2) increase muscle activity, and 3) reduce lower back pain.[4] Some evidence does exist that indicates that

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wearing MBT shoes produces instability during standing[5,6] and walking,[7] and that prolonged wearing of MBT shoes can improve static balance ability.[8] In addition, reduction of joint moment[9–11] and altered kinematic changes of the ankle joint[6,12,13] during walking have been confirmed. An increase in muscle activity while wearing MBT shoes has also been noted in many studies.[4,6,9,10,13,14] There is also evidence that wearing MBT shoes can reduce the pain of knee osteoarthritis[8] and that of the lower back.[15] In addition to these effects, a number of MBT shoe users have reported that MBT facilitates recovery from exhaustive muscle fatigue (information from Evernew Corporation; also marketing claim of MBT shoes). To this point, there is no scientific evidence that supports these observations.

The purpose of this study is to evaluate whether wearing MBT shoes facilitates recovery from the muscle fatigue that follows the completion of a full marathon.

Materials and methods

Shoes

Two types of shoes were assigned to the participants to wear after a full marathon race. One type was the MBT shoe (Figure 1). The other type assigned (as a stable shoe) was the sports shoe, which is commonly used for trail running (TR). This shoe has a flat sole and is not unstable. Both MBT shoes and sports shoes are distributed by Evernew Corporation in Japan. The control group was told to wear what they normally wore after a race.

Subjects

The subjects were openly recruited from two club teams of Waseda University through recruitment information on the team websites and mailing lists. The inclusion criterion for participating in this study was that the subject's foot size fit the test shoes available for the experiment (22.5~26.0 cm). Forty-five university students who registered for the Second Fujisan Marathon (42.195 km; November 24, 2013) participated in this study. They were divided into the three groups described earlier. Based on pre-questionnaires, the groups were matched for foot size and targeted race time. All groups put on their assigned shoes immediately after the race and wore them for the next 3 days of their everyday life. Group 1 was the MBT group (mean age 21±1 years; mean BMI [body mass index] 20.3±1.4; n=15 [seven males and eight females]). Group 2 was the TR shoe group (mean age 21±2 years; mean BMI 19.5±2.1; n=14 [seven males and seven females]) and group 3 was the control (CON) group (mean age 21±1 years; mean BMI 21.0±1.3; n=16 [seven males and nine females]). No subject in any of the groups had prior knowledge of the MBT or TR shoe.

Figure 1 Illustration of the MBT shoe used in the study.
Abbreviation: MBT, Masai Barefoot Technology.

Before the experiment, written informed consent was obtained from all subjects. The study was approved by the Human Research Ethics Committee of Waseda University (2013-216).

Protocol

Subjects ran the race in their own running shoes. Immediately after finishing the race, subjects of the MBT and TR groups changed into the MBT or TR shoes. In addition, subjects of the MBT group received a short lecture on how to use the MBT shoes. After the race, subjects of the MBT and TR groups wore the assigned shoes in their daily life except when they were in their own or in others' houses (the Japanese custom is to not wear shoes in the home) or during sports activities. The only requirements of the subjects were to wear the assigned shoes and to answer the questionnaires.

Subjective muscle fatigue with questionnaires

The subject's degree of muscle fatigue was expressed on a 12 cm visual analog scale (VAS)[16] where 0 cm indicated 'comfortable with no fatigue' and 12 cm represented 'too exhausted to do anything'. Each participant answered the questionnaires five times in total. On the day of the marathon, the participants answered the questions before the race (Pre) and immediately after finishing the race (Post). For the following 3 days, the questionnaires were completed in the morning. In addition to the estimates of fatigue, race performance (derived from the official records of the race), total walking time for the assigned condition, and length of time spent wearing the assigned shoes (we did not get this information for the CON group, because the subjects of the CON group did not have to wear shoes) during each day (except day 3) were reported.

Data analysis

The estimates on the VAS were rescaled as percentages of the possible maximum (0 cm =0%, 12 cm =100%). For statistical analyses, the time course utilized was: Post, day 1, day 2, and day 3 after the race. The second factor was the group: MBT, TR, and CON. A two-way analysis of variance (ANOVA) (4 days ×3 groups) was performed on the above factors. In addition, differences in fatigue among the three groups on day 3 were also examined by unpaired *t*-tests. A comparison of the fatigue in the Pre with that on day 3 was also done by utilizing paired *t*-tests. The walking time for each of the 3 days was averaged for each day, and then a one-way ANOVA (three groups) was performed. The times recorded for the race were also analyzed by a one-way ANOVA (three groups). The length of time spent wearing the assigned shoes in the MBT and TR groups was compared by utilizing a paired *t*-test. Prior to performing parametric statistical analyses, the normality and equality of all data were confirmed by Shapiro–Wilk and Levene's tests, respectively.

Results

All subjects were able to complete the full marathon race. There was no main effect of group in the times recorded for the race (F[2, 42] =0.73, P=0.49; Table 1). The time spent walking for the 3 days also did not show a main effect of group (F[2, 42] =1.69, P=0.20; Table 1). The length of time spent wearing the assigned shoes in the MBT and TR groups did not statistically significantly differ (P=0.80).

For the feeling of fatigue evaluated utilizing the VAS, a two-way ANOVA indicated a significant main effect of day (F[3, 167] =54.15, P<0.001) as well as a significant main effect of group (F[2, 167] =3.19, P<0.05). No significant interaction was found (F[6, 167] =0.57, P=0.80). On day 3, the feeling of fatigue was significantly lower for the MBT group than for the CON group (P<0.05) or the TR group (P<0.05). No difference between the CON and TR groups was found (P=0.64; Figure 2). Lastly, comparisons of the fatigue experienced before the race (Pre) and on day 3 showed a difference between TR_Pre and TR_day 3 (P<0.001), and CON_Pre and CON_day 3 (P<0.001), but no difference between MBT_Pre and MBT_day 3 (P=0.31).

Table 1 Marathon performance, averaged walking time per day, and length of wearing time per day with the assigned shoes

	MBT	TR	CON
Time of the race (h)	4.13±0.85	4.14±0.83	4.45±0.89
Walking time (h)	1.71±1.12	1.31±0.81	1.26±0.71
Wearing time (h)	7.87±2.00	8.08±2.38	

Notes: No difference between the groups was found. Values are expressed as mean ± standard deviation.
Abbreviations: CON, control; MBT, Masai Barefoot Technology; TR, trail running shoes; h, hours.

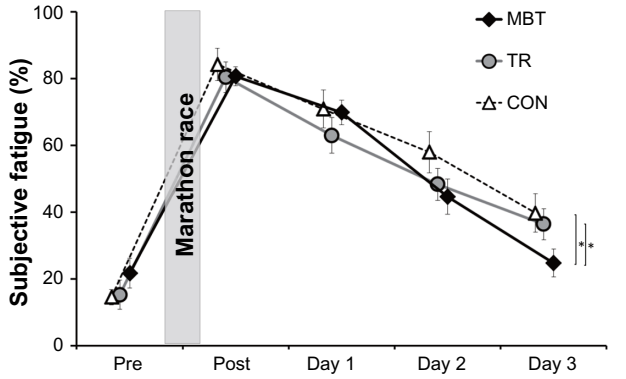

Figure 2 Subjective fatigue pre- and post-marathon race and after 1, 2, and 3 days of recovery.
Notes: Asterisks indicate the significant differences on day 3 (P<0.05). Values are expressed as mean ± standard error.
Abbreviations: CON, control; MBT, Masai Barefoot Technology; pre, pre-marathon race; post, post-marathon race; TR, trail running shoes.

Discussion

The objective of this study was to investigate the potential value of MBT shoes on the recovery from exhaustive fatigue induced by running a full marathon. The results of this study indicated that the MBT shoes promoted recovery from perceived fatigue. While subjective fatigue was similar among the three groups before and immediately after the race, subjective fatigue in the MBT group was less than that of the CON and TR groups on day 3. The lack of a difference in subjective fatigue of the MBT group between the Pre and day 3 indicated that the fatigue was largely gone by day 3. On the other hand, significant differences in subjective fatigue for the CON and TR groups between the Pre and day 3 values indicate that fatigue still remained on day 3 for these groups. In addition, the lack of a difference between the CON and TR groups at any time during recovery demonstrates that wearing a new type of shoe did not affect the results (no placebo effect). Also, the absence of a difference in the marathon performance between the three groups indicated that running abilities were similar for the three groups. In addition, there was no difference in the daily length of time spent walking between the three groups nor in the difference in wearing time for the assigned shoes. Therefore, the race performance or exercise volume in daily activity during the recovery period were not important factors in determining the speed of recovery after the race. Thus, wearing the MBT shoes had a positive effect on recovery from severe fatigue following exhaustive exercise.

How did the wearing of MBT shoes promote the recovery from fatigue? It has been suggested that wearing MBT shoes increases activity in lower limb muscles, including the triceps surae,[10,13] tibialis anterior,[6] quadriceps,[10] and other small muscles.[4,5] Maximal forces that could be exerted by the knee extensor and plantar flexor decrease after marathon running.[17–19] This suggests that, minimally, the knee extensor and plantar flexor muscles show compromised function as well as subjective fatigue following the race. One possibility is that wearing the MBT shoes increased the activity of the fatigued muscles. This activity may aid in an 'active recovery'. Generally, exercises that involve a slightly higher intensity (active recovery) after exhaustive exercise promote a more effective recovery from fatigue as compared with passive recovery, which involves no specific exercise.[20] In addition, since walking with MBT shoes increases the angle of dorsiflexion,[6,13] a stretching of the plantar flexor muscles might also occur. Thus, the wearing of MBT shoes would be expected to promote stretching of the lower limb muscles and thus enhance the activity in those muscles. This would result in increased muscle blood flow, which would lead to an increased removal of lactic acid. Lactic acid concentration is generally utilized as a biochemical marker of muscle fatigue.[21]

Although an enhanced recovery by wearing MBT shoes was clearly indicated by this study, some limitations on the findings exist. First, since the fatigue evaluation involved only a subjective questionnaire, various types of personal bias could not be completely removed. When utilizing only a questionnaire, it is difficult to determine the physiological mechanisms involved in the fatigue recovery provided by the MBT shoes. Second, we did not obtain data on the time and behavior spent while not wearing the shoes. Therefore, we cannot thoroughly eliminate the effect of factors other than wearing of the shoes on the present results. Third, we should have utilized a device like an acceleration meter to objectively measure the subject's physical activity. Lastly, we did not constrain the subject's behavior after the race except for requiring the wearing of the assigned shoes. Some subjects might have trained hard even after the marathon race, while others might have performed little or no physical activity, which might explain the large variability seen in the data. Such limitations are almost unavoidable in a clinical study such as this one. Further experimentation which would include the measurement of biochemical and biomechanical markers in a laboratory setting will be expected to elucidate the physiological underpinning of the recovery effect elicited by wearing MBT shoes. Such results, if positive, would also enhance the validity of this study. Nevertheless, this study clearly supports the usefulness of MBT shoes in clinical applications.

Results of the present study suggest the usefulness of MBT shoes in conditioning not only for athletes, but also for recreational use. Recreational activities can also involve exhaustive exercise and can produce strong fatigue. Recovery from this fatigue could likely be speeded up simply by wearing MBT shoes during everyday life.

Conclusion

Using MBT shoes during everyday activities promoted recovery from the exhaustive fatigue induced by running a full marathon. This finding has significant clinical implications for both athletes and lay people.

Acknowledgments

We are grateful to Dr Larry Crawshaw for editing the English in the manuscript, and to Track and Field Hobby Club at Waseda University and Triathlon Team Northwest for providing the subjects.

Disclosure

Although Evernew Corporation provided the experimental shoes and financial support, they had no role in 1) the study design, 2) analysis and interpretation of the data, and 3) the writing of the manuscript. The authors report no other conflicts of interest in this work.

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