A BIOMECHANICAL COMPARISON OF KENYAN AND JAPANESE ELITE LONG DISTANCE RUNNER'S TECHNIQUES

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INTRODUCTION

It is recognized that Kenyan runners have an excellent record in running events of various distances: they have mastered running techniques for the acquisition and maintenance of high speed over long distances. Although there are many world class Japanese long distance runners, comparing their running techniques with those of Kenyan elite runners seems to reveal differences in efficiency. This study will attempt to show reasons for the high performance of Kenyans through biomechanical analysis of their running techniques. The purpose of this study is to compare the running techniques of Kenyan and Japanese elite male long distance runners in 5000 m races.

METHODS

Official 5000 m races were videotaped with a digital video camera at 60 Hz in the 2003 IAAF Grand Prix in Osaka; the 2004 Super Athletic Meets in Yokohama; and the 2004 Inter-high School Athletic Competition. Videotapes of nine Kenyan and nine Japanese runners were digitized through out the running cycle at the 2000 m and 4000 m marks. Their height, body mass, and race record were 1.69 m, 55.1 kg, 13 min 24.08 sec for Kenyans and 1.73 m, 55.8 kg, 13 min 34.92 sec for Japanese, respectively. Kinematic and kinetic variables were calculated using two-dimensional motion analysis. Joint and segment angles, center of mass, joint torque, and power of the lower limb were calculated for the evaluation.

RESULTS AND DISCUSSION

Running velocity at the 2000 m and 4000 m marks was 6.16 and 6.28 m/s for the Kenyan and 6.08 and 6.11 m/s for the Japanese. There was no significant difference in running velocity, step length and step frequency. However, relative step length to the body height was greater in the Kenyans than the Japanese.

There were few significant differences in lower limb angles and angular velocities between the Kenyan and the Japanese runners. One of the greatest differences was shown in the mean torso angle of the cycle, which indicates that Kenyan runners ran with greater forward lean of the torso than the Japanese. Ankle joint angle at toe-off and angular displacement in the second half of the support phase were greater in the Japanese than the Kenyans. Thigh and shank angular velocity in the recovery phase tended to be greater in the Kenyans than the Japanese but there was not a statistically significant difference. The peak values of the joint torque and power at knee joint in the late recovery phase were greater in the Kenyans than the Japanese. These results suggest that hip and knee joint movement relative to the ankle joint was greater in the Kenyans than the Japanese.

The figure below shows stick pictures at each point in the cycle and the locus of the center of mass of the lower limb (CMleg) for typical subjects at the 4000 m mark, subject A is a Kenyan and subject B is a Japanese runner. It is shown that the locus of CMleg for subject A shows a wider and higher ellipse than subject B. There were significant differences in the horizontal displacement (range of horizontal movement) of CMleg relative to the body height and the maximum horizontal (forward) velocity of CMleg relative to the center of mass of the body between the Kenyan and Japanese runners. It is important for a distance runner to swing both legs forward and backward coordinately in order to reduce energy waste [1]. These results suggest that the Kenyan runner swung the leg forward faster and more broadly so as to efficiently acquire the higher running velocity.

CONCLUSIONS

One of the most significant characteristics of the Kenyan runner was the forward lean of the torso. Movement of the center of mass of the lower limb was greater and faster for the Kenyans than the Japanese, which indicates that the Kenyan runner could swing the leg forward faster and more broadly.

REFERENCES

1. Williams KR, Cavanagh PR. *Journal of Applied Physiology* **63**, 1236-1245, 1987.

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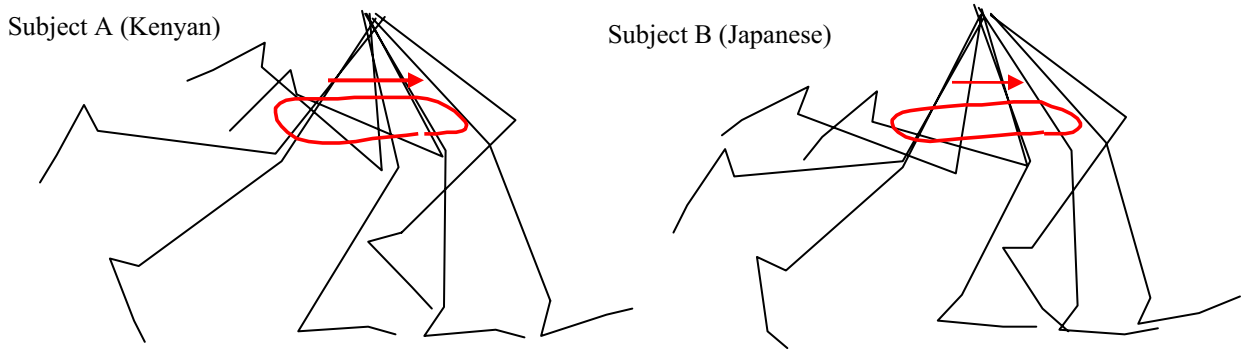

Figure Stick pictures at each point in a cycle and a locus of the center of mass of lower limb for typical subjects at 4000 m mark.