The relationship between leg length and velocity of center of gravity during contact phase in the long jump

[1] Kenji Ohishi , [1]Tetsunari Nishiyama and [2]Kazuhisa Anraku
[1] Human Performance Laboratory, Nippon Sport Science University, [2]Physical Training School of Japan Defence Forces
e-mail: kenji@nittai.ac.jp, web: http://www.nittai.ac.jp/

INTRODUCTION

The take-off velocity of the center of gravity (CG) is one of important factors in the performance of the long jump. The horizontal velocity of CG gained by approach run was decelerated during the contact phase. Therefore, it is important to study the mechanisms of velocity changes during the stance phase. We examined the relationship between the changes of the CG velocity and leg length of the take-off leg during foot contact phase.

METHODS

Ten male long jumpers and ten male no-athletes participated in this study. The long jump movement during foot contact phase of take-off was recorded in the sagittal plane at 250f/s using high-speed video camera (nac, inc.). Two –dimensional coordinates of each marker on whole-body of subjects were obtained using MOVIAS software (nac, inc.). The kinematics data were smoothed two-order digital Butterworth low-pass filter with a cutoff frequency of 8Hz.

The horizontal and the vertical velocity of CG and the leg length were calculated from the coordinates. The leg length is defined as the distance from the CG to the point of metatarsophalangeal joint. The leg length was normalized to the length at the take-off. And, horizontal velocity of the CG was normalized to the horizontal velocity of the CG at the touchdown.

RESULTS AND DISCUSSION

The mean long jump distance was 6.99(6.31-7.33) m in the athlete, and 4.97(4.33-6.13) m in the non-athlete.

The %leg length was decreased in the first half of foot contact phase, then it was lengthened during the last of phase. The first half was defined as the period from touchdown to the appearance of shortest %leg length, and the latter half was defined as the period from the appearance of shortest %leg length to take-off.

Figure show the relationship between ⊿%horizontal velocity at the latter half and %horizontal velocity at the take-off. In all the members, there was the significant relation. This result show that the increase of ⊿%horizontal velocity at the latter phase approaches the velocity of approach run. However, there was no correlation in the athlete and no-athlete groups.

The relationship between velocity of CG and ⊿%leg length was show in the table. And, there was the correlation on ⊿%leg length at the latter half and it at the first half. In all the members and athlete group, there was the significant relation in ⊿% horizontal velocity at the latter half and ⊿%leg length at the same phase($p < 0.05$). The significant relation could not be observed between other elements.

From these results, there was no relation on ⊿%leg length and ⊿velocity of CG in many phases. However, the ⊿%leg length affects the ⊿%horizontal velocity of CG at the take-off, which ⊿%leg length will be considered as one element of the performance decision.

REFERENCES

1. Seyfarth A., Friedrichs A. et.al. *J Biomech* **32**, 1259- 1267,1999.

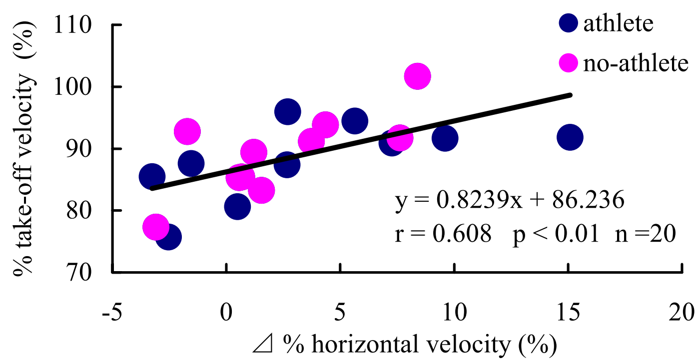

Figure. The relationship between ⊿% horizontal velocity at the latter half and %horizontal velocity at the take-off.

Table. The value of correlation coefficient and level of significance

		⊿%leg length at the first half			⊿%leg length at the latter half		
		all(n=20)	athlete(n=10)	no-athlete(n=10)	all(n=20)	athlete(n=10)	no-athlete(n=10)
⊿vertical velocity	first half	0.177	-0.527	-0.379	0.402	0.454	0.026
		ns	ns	ns	ns	ns	ns
	latter half	-0.120	-0.366	-0.019	0.273	0.610	-0.140
		ns	ns	ns	ns	ns	ns
⊿%horizontal velocity	first half	0.131	-0.028	0.028	0.051	0.294	-0.289
		ns	ns	ns	ns	ns	ns
	latter half	-0.283	0.449	-0.014	-0.453	-0.679	-0.329
		ns	ns	ns	0.05	0.05	ns