KINEMATICAL ANALYSIS OF 110M HURDLES
- FOCUSING ON THE STEP LENGTH

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INTRODUCTION: The adaptations to each of the four steps are required for good performance in 110m hurdles (McDonald, 2002). However, the motions related with both running velocity and step length are not studied yet. Thus the purpose of this study was to investigate kinematic characteristics of 110m hurdlers with reference to step length.

METHODS: Twenty nine male hurdlers (Height: 1.84±0.05m, Mass: 74.6±6.9kg, Time in analyzed race: 13.77±0.45 s) participated in this study. The motions from the 6th to 7th hurdles (1cycle) were videotaped during world and Japanese top class official competitions. The kinematical parameters primarily analyzed were: 1) running velocity (RV), which was defined as the average of the horizontal CG velocities during 1cycle; 2) vertical velocity of the CG at the takeoff of the 2nd step; 3) step length, which was defined as the distance between the toe at the 2nd and 3rd steps; 4) step frequency, which was defined as the inverse of the duration of the 2nd step; 5) thigh angle; 6) landing distance (LD), which was defined as the distance from the hurdle to the toe at the touchdown; 7) support time, which was defined as the duration from the foot contact to the toe off; and 8)air time, which was defined as the duration from the toe off to the foot contact. A multiple regression analysis was conducted with RV and LD as independent variables with P at .05.

RESULTS: Table 1 shows the result of multiple regression analysis with kinematical parameters at the 2nd step as dependent variables. Step frequency positively correlated with RV. Support time, air time and vertical velocity of the CG at the takeoff of the 2nd step were negatively correlated with RV. Figure 1 shows the thigh angle of trail-leg during 1 cycle, which was normalized at 100%, with significant differences of RV and LD. In the 2nd step (2on-3on, 6-27%), the thigh angle was negatively correlated with RV (5-10%), and positively correlated with RV (16-22%). There was no significant difference with LD.

Table 1 The Effect of running velocity and landing distance.

Dependent variables (mean±SD)	Independent variables (β)		R^2
	RV (m/s)	LD (m)	
Step length (2.00±0.08 m)	-.026	-.279	.074
Step frequency (4.30±0.23 s^{-1})	.784***	.137	.562***
Support time (0.13±0.01 s)	-.699***	-.066	.462***
Air time (0.11±0.01 s)	-.493*	-.029	.235*
Vertical velocity of CG at takeoff (0.25±0.16 m/s)	-.581**	-.158	.301**

* : $p < .05$, ** : $p < .01$, *** : $p < .001$

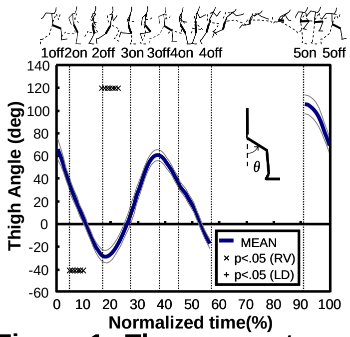

Figure 1: The segment angle of thigh of trail-leg during 1

DISCUSSION: It is thought that faster hurdlers shortened support time of the 2nd step by a toe-contact nearer the CG at touchdown. The small range of motion of the thigh during the 2nd step was effective for reducing vertical velocity of CG at takeoff and shortened air time. Faster hurdlers achieved shortened support and air times and higher step frequency of the 2nd step.

CONCLUSION: The results of this study revealed that the motions to achieve higher step frequency during the 2nd step were effective for good performance of 110m hurdles.

REFERENCES: McDonald, C. (2002). Hurdling is not sprinting. *Track Coach 161,* 5137-5143.