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Technique index in a shorter inter-hurdle distance reduces the physical growth level in hurdle physical education

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INTRODUCTION

In school physical education (PE), a hurdle running class provides students to enhance the fundamental physical ability to jump and run in turn [1]. Because the student has to maintain high running speed during the hurdle running trial, the finish time is directly related to the sprinting ability [2]. However, the effect of sprinting ability to the hurdle running record should be reduced so that a teacher assesses the hurdle running skill of the students by absolute evaluation in PE. Therefore, some teachers in PE class are scoring the hurdle running skill of the student by the time difference between hurdle running record and sprinting record: the technique index.

Motor skills in adolescent are largely affected with the physical growth level. Thus, the hurdle running record and the technique index of the student would be related to physical characteristics including height and muscle strength.

Various inter-hurdle distances are prepared in hurdle PE in contrast to hurdle regulation of the athletic event. Thus, the student is needed to adjust their clearing hurdles and/or running movements based on the distance between hurdles. In this learning environment, the sprinting ability, physical characteristics and muscle strength would be not merely the determinant of the technique index.

Therefore, the first purpose of this study was to investigate that how the technique index in various inter-hurdle distances relates to the physical characteristics and muscle strength in PE. The second purpose of this study was to investigate how relationships between the technique index and the joint kinematics change according to the inter-hurdle distances.

METHODS

Fifteen boys (age, 13.1 ± 0.3 yr; height, 1.53 ± 0.09 m; body mass, 38.7 ± 5.4 kg; mean ± standard deviation [S.D.]) of junior high school were participated in this study.

Three different inter-hurdle distances (5.5, 6.0 and 6.5 m) were set up using five hurdles (68 cm high) on tartan mat indoors. After two lessons of the hurdle running, the participants performed a 50-m sprint dash and each 50-m hurdle run in the three inter-hurdle distances once with randomized order. We calculated the technique index of hurdle running by the following equation.

Technique index (s) = 50-m hurdle running record (s) − 50-m hurdle running record (s)

Fifteen high-speed cameras (Raptor-E digital; Motion Analysis Corporation, Santa Rosa, CA, USA) sampled at 250 Hz to capture the movement of hurdle clearance at the second hurdle (hurdle phase). Extension–flexion angles of hip, knee and ankle joint angles were determined using a joint coordinate system.

The muscle strength was assessed by following three tests. The maximum voluntary isometric strengths of hip extension and flexion were measured three times with randomized order using Biodex system (Minato Ikagaku Corporation, Tokyo, Japan). Countermovement jump and standing long jump were measured three trails. The best performance in each muscle strength tests was used in analysis.

RESULTS

Greater technique index significantly relates to height, body mass, and all muscle strengths in the 6.0 and 6.5 m inter-hurdle distances (Table 1). In contrast, the technique index in a 5.5 m inter-hurdle distance did not relate to height, body mass, and all muscle strengths.

Greater technique index significantly correlated with the clearance distance in the 6.5 m inter-hurdle distance ($r = -0.59$, $P < 0.01$). In contrast, the technique index did not significantly correlate to the clearance distance in the shorter inter-hurdle distance. Greater hurdle technique in a 5.5 m inter-hurdle distance related to smaller maximal hip flexion angle of the leading leg at the aerial hurdle phase ($r = -0.53$, $P < 0.05$) (Figure 1). In contrast, the technique index in 6.0 and 6.5 m inter-hurdle distances did not significantly correlate to the maximal hip flexion angle of the leading leg at the aerial hurdle phase. In a 5.5 m inter-hurdle distance, greater technique index significantly related to smaller maximal hip flexion angle of the trailing leg at the aerial hurdle phase ($r = -0.53$, $P < 0.01$), that in the 6.0 and 6.5 m inter-hurdle distance, however, did not significantly related to the flexion angle.

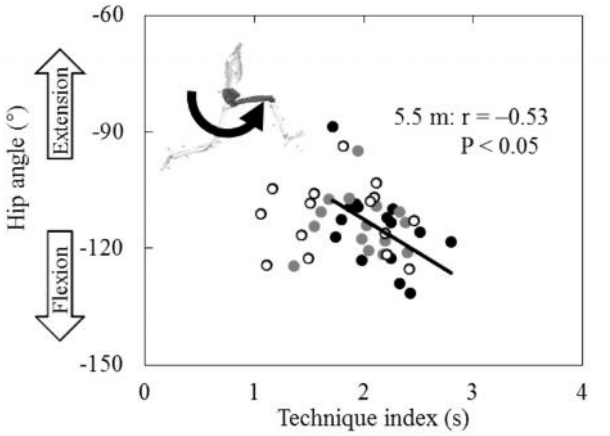

Figure 1: Scatter plot of the hurdle technique versus maximal hip flexion angle of the leading leg at the aerial hurdle phase. The black, gray and white circles show the result in 5.5, 6.0, and 6.5 m inter-hurdle distance, respectively.

DISCUSSION

The important finding of this study was that the major influences of the physical characteristics and the muscle strength can be reduced from the technique index in a shortened inter-hurdle distance. Furthermore, the greater technique index in the shorter inter-hurdle distance was mainly contributed with the smaller clearance movement of lower limbs.

In school PE, motor skills of a student are evaluated based on the objective aimed by Guidelines for Courses of Study in Japan and their teachers. Because of enhancing the positive attitude for physical activity of all students, the motor skills is currently assessed whether the student can absolutely achieve the preparing standard, and is not relatively assessed compared to the skill of the other students. The finding of this study suggests that the absolute evaluation of the hurdle running class may be directly achieved by measuring the technique index in a shorter inter-hurdle distance.

Smaller clearance movement such as smaller maximal flexion movement of both leading and trailing legs at the aerial hurdle phase enhanced their technique index in a shorter inter-hurdle distance. To our knowledge, this smaller hurdle movement is not currently recommended as the aimed motor skill in PE class. Thus, the new evaluating standard for the absolute evaluation should be prepared in the feature hurdle PE class.

CONCLUSION

We concluded that the influences of the physical characteristics and the muscle strength can be reduced from the technique index in a shorter inter-hurdle distance. Furthermore, greater technique index in the shorter inter-hurdle distance was mainly contributed with the smaller clearance movement of lower limbs at the aerial hurdle phase.

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Table 1: Relationship between the technique index and physical characteristics and muscle strength

Performance	Technique index (s)		
Inter-hurdle distance	5.5 m	6.0 m	6.5 m
Height (m)	−0.44	−0.76**	−0.75**
Body mass (kg)	−0.35	−0.74**	−0.63*
Hip strength (Nm)			
Extension	−0.42	−0.59*	−0.46
Flexion	−0.36	−0.59*	−0.46
Countermovement jump (m)	−0.10	−0.64*	−0.60*
Standing long jump (m)	−0.20	−0.64*	−0.67**

Note: Statistically correlated with the technique index are indicated with asterisks, * $P < 0.05$ and ** $P < 0.01$.