Relationship between Joint Kinetics of Vertical Jumps and Age in Preschool Children

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Summary

This study investigated the relationship between lower limb joint kinetics during vertical jumps and growth in preschool children. Eleven children (7 boys and 4 girls) performed vertical jumps, which were recorded using a motion capture system and a force platform. Joint moments and moment powers of the ankle, knee, and hip were calculated. The results showed a significant positive correlation between age and jump height. Except for peak knee moment, all peak joint moments and moment powers were significantly associated with both age and jump height. These findings suggest that as preschool children grow, they not only increase joint moment production but also improve their jumping technique. This improvement could contribute to enhanced jump performance.

Introduction

During preschool years, children develop fundamental motor skills, including walking, running, and jumping. Understanding how preschool children improve these skills can provide valuable insights. The purpose of this study was to clarify the relationship between lower limb joint kinetics during vertical jumps and growth in preschool children.

Methods

Eleven preschool children (7 boys and 4 girls) participated in this study (age: 59 ± 10 months, height: 106.1 ± 7.7 cm, weight: 17.5 ± 2.7 kg). This study was approved by the Ethics Committee of the Faculty of Liberal Arts, Sciences, and Global Education, Osaka Metropolitan University. The participants performed 6 to 10 countermovement vertical jumps from a standing position (hands on hips) on a force platform (Kistler, 9281E). Jump motion and ground reaction forces were measured using a Vicon motion capture system (200 Hz) and the force platform (1000 Hz). The last four successful trials were selected for analysis. The location of the center of mass, the mass, and the moment of inertia for the participants' body segments were estimated using Japanese children's body segment parameters [1]. Jump height was calculated from the vertical ground reaction force. Joint moments and joint moment powers of the ankle, knee, and hip were obtained using an inverse dynamics method. Pearson correlation coefficients were calculated between peak extension moments and positive powers and the participants' age (in months) and jump height.

Results and Discussion

The mean jump height was 9.6 ± 2.8 cm and showed a significant positive correlation with age (Figure 1). Table 1 presents the peak joint moments and joint moment powers of the hip, knee, and ankle, along with their correlation coefficients with age and jump height. Except for peak knee moment, all peak joint moments and powers were significantly correlated with both age and jump height. These results indicate that as preschool children grow, they not only develop greater joint moment production but also improve their jumping technique, which could contribute to enhanced jump performance.

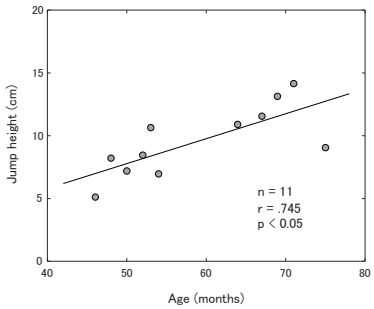

Figure 1 Relationship between age (in months) and jump height.

Table 1 Peak joint moments and powers and their correlation coefficients (CCs) to age and jump height.

	Peak	CC to age in month	CC to jump height
Moment (Nm/kg)			
Ankle	0.76 ± 0.14	.790*	.930*
Knee	0.61 ± 0.13	.407	.476
Hip	0.72 ± 0.14	.610*	.761*
Power (W/kg)			
Ankle	5.24 ± 1.51	.699*	.786*
Knee	3.67 ± 0.90	.811*	.831*
Hip	3.16 ± 0.80	.654*	.808*

* : $p<0.05$

Conclusions

This study demonstrates that lower limb joint moments and moment powers improve with age, and these improvements play an important role in enhancing jump performance in preschool children.

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References

[1] Yokoi et al. (1986). *Japan Journal of Physical Education, Health and Sport Sciences*, **31**: 53-66.