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6655 Mo–Tu, no. 38 (P61)

The validity evaluation for vertical jump meter

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The vertical jump meter that acquires the change of length by pulling the rope out of pulley is one of many convenient and instantaneous tools to assess the performance of counter movement jumping. But it is necessary to examine its validity by using the vertical jump meter to measure the displacement for center of gravity. Four participants, two boys and two girls, were asked to perform the maximal counter movement jump on the Kistler force platform (type: 9287BA; sampling rate: 1000 Hz) for 20 times. A vertical jump meter (Takei Scientific Instruments Co., Ltd, Item No. 5106) was used to record every jump height synchronously. The height of the center of gravity during the jump was calculated from ground reaction force by the impulse-momentum relationship and was served as the criterion. The mean jump heights from force platform were 37.5±1.1 cm, 39.4±1.8 cm, 54.5±2.5 cm, and 53.7±2.3 cm for each participant, and the standard errors of estimate for vertical jump meter were 1.4 cm, 1.2 cm, 4.2 cm, and 2.7 cm respectively. The result of linear regression analysis showed that the best-fit line was totally different for the four participants. It demonstrated the source of measurement error was not regular but also participant independent for the validity of vertical jump meter. This study was inadaptable to formulate a regression function between the vertical jump meter and the criterion. In the process of average or maximum for the first three to four times of jump, the measurement of counter movement jump by the jump meter was controlled threat to validity and minimized error of estimate less than 1 cm.

6656 Mo–Tu, no. 39 (P61)

Is age-related difference in vertical jump a function of arm swing and stretch shortening cycle for children?

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Motor development researchers always regard the proper use of limb swing or proper use of countermovement as the critical indexes for motor skill in child transition to the mature stage. The peak height during a vertical jump is actually enhanced through the effect of vigorous arm swing and the effect of stretch shortening cycle (SSC) that countermoves the lower extremities. The purpose of this study was to investigate the age difference of the effect of arm swing and SSC in middle/later childhood. Ten boys for each age group (7-year-old, 9-year-old, and 11-year-old), 30 in total, were recruited as the participants and were asked to perform squat jump (SJ), countermovement jump (CMJ) without arm swing, and countermovement jump with arm swing. A Kistler Quattro jump force platform system (500 Hz) was used to acquire and to assess the performance of vertical jump. The results showed there was no age-related difference ($p > 0.05$) for the jump height of CMJ without arm swing (7-year-old: 25.3±4.8 cm; 9-year-old: 26.9±4.2 cm; 11-year-old: 29.1±5.3 cm). The jump heights in SJ and CMJ with arm swing were significantly higher ($p < 0.05$) for 11-year-old boys (SJ: 27.9±4.1 cm; CMJ-arms swing: 35.6±5.4 cm) than for 7-year-old boys (SJ: 22.9±3.2 cm; CMJ-arms swing: 27.3±4.3 cm). Neither 7-year-old boys nor 11-year-old boys had statistical difference with 9-year-old boys for the jump height of three types of vertical jump. It indicated that age nine is the critical stage for the development of vertical jump. This study calculated the enhanced rates of arm swing effect and SSC effect, and found there were no statistical differences among 7-year-old boys (SSC: 10.0±10.6%; Arm swing: 10.9±21.5%), 9-year-old boys (SSC: 8.2±10.7%; Arm swing: 18.0±15.1%), and 11-year-old boys (SSC: 4.3±12.6%; Arm swing: 23.6±10.3%). But the variability of enhanced rates within every age group for SSC effect and arm swing effect were considerably large.

7003 Mo–Tu, no. 40 (P61)

Long jump technique of elite female lower-limb amputee athletes

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Elite male amputee athletes conform to the established able-bodied long jump model, but with some adjustments to technique (Nolan and Lees, 2000). It is not known, however, what adjustments female amputee athletes make, though it has been shown that female trans-femoral amputees do not conform to the long jump model at all (Patritti et al., 2005). The purpose of this study was to investigate the long jump technique used by female trans-femoral (TF) and trans-tibial (TT) amputee athletes.

During the 2004 Paralympic Games long jump finals, 8 female TF and 9 female TT athletes were videoed (sagittal plane at 50 Hz) to include the third last step through to take-off. The best jump for each athlete was digitised, and key kinematic variables were calculated at each step, touch-down and take-off. Mann-Whitney U tests established differences between groups, while Wilcoxon tests indicated differences between steps.

The TF athletes were slower, more upright and had a consistently higher centre of mass (CM) on the last three steps prior to take-off than the TT athletes. However, from the last step to touch-down, TF athletes lowered their CM so that they were actually lower on the take-off board than TT athletes. This not only resulted in a greater negative vertical velocity at touch-down (TF: $-0.39\pm0.18\,\mathrm{m\,s^{-1}}$, TT: $-0.18\pm0.20\,\mathrm{m\,s^{-1}}$), but excessive lowering of the CM without sufficient eccentric leg strength may cause the leg to 'buckle' (Dapena, 1987), limiting jump distance. This may explain why female TF athletes do not conform to the long jump model, and suggests adjusting the lowering of the CM onto the take-off board may improve jump distance.

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4442 Mo–Tu, no. 41 (P61)

Vertical jump height represents a body size independent index of muscle power

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In the present study we tested the hypothesis that the performance of rapid movements represents a body size independent index of muscle power. Physical education subjects ($n = 159$) were tested on various vertical jump and leg extensor strength tests. Both the jump height and average power were calculated from the ground reaction force during jumping. Principal component analysis (PCA) applied on all vertical jump measures, leg extensor strength tests and body size indices revealed a complex and inconsistent structure of the three extracted principal components were the jump height and muscle power loaded different components, while muscle strength and power partly overlapped. However, when the indices of muscle strength and power were normalized for body size using theoretical predictions of geometric similarity (i.e. divided by mass$^{0.67}$), a simple and consistent structure of principle components appeared to be in line with the hypothesis. Specifically, the recorded height and muscle power calculated from the same jumps loaded the same components, separately for the jumps predominantly based on concentric and those based on a rapid stretch-shortening cycle of leg extensors. The third and fourth extracted principal components were loaded with the indices of the leg extensor strength and body size, respectively. If supported by future studies performed on other rapid movements, the finding that the performance of rapid movements assess the same physical ability as properly normalized tests of muscle power could be of exceptional importance for designing and interpreting the results of batteries of physical performance tests, as well as for understanding some basic principles of human movement performance.

7628 Mo–Tu, no. 42 (P61)

Analysis of the plantar foot pressure during walking: VFE position and VRI position

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Objective: The lower limb in standing position oscillates between two extreme positions of stability. In dribble and race, the lower limb goes from VFE (Valgus-Flexion-External) position to VRI (Valgus-Flexion-Internal) position. The VFE rotation raises the external ark of the foot through the intermediary of the fibular