KINEMATICS ANALYSIS OF THE BARBELL OF YOUTH WEIGHTLIFTERS
DURING MAXIMUM SNATCH
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ABSTRACT
The majority of the research to date on weightlifting has focused on two senior female 2004 and 2008 Olympic gold medal weightlifters. The performances of 6 women weightlifters were Thai Youth National Team and performing in the final selected for the representative of Thailand national weightlifter in the Youth Olympic Games 2010 competition in Singapore. The kinematics data of the barbell were recorded and analyzed using Peak Motion Analysis. 2-D Motion Analysis system from the snatch lift including barbell resultant trajectory, vertical and horizontal displacement, peak height, velocity, and acceleration. The performance of the athletes competing in 69-kg class and 48-kg class and the average age 15.8 years old the snatch attempts only once performance with the maximum lifting. The results showed that the average of barbell peak height were 1.29±0.1m, vertical barbell displacement 0.144±0.03m, horizontal barbell displacement 0.18±0.28 m, maximum vertical barbell velocity 2.84±0.26 m/s at 31±4 time % snatch, and maximum vertical barbell acceleration 23.59±4.34m/s² at 29±6 time % snatch, respectively. The results of this study suggest that the appearance of the second pull in maximum vertical velocity and acceleration with time % snatch of weightlifters could be used as a criterion of lifting skill and a measure of performance.

KEYWORDS: kinematic, snatch, youth weightlifter

INTRODUCTION
Weightlifting consists of two events, the snatch and the clean and jerk. (IOC www.olympics.org, 2006). Thailand has two women weightlifters received two gold medals from the Olympic Games in 2004 and 2008. Nowadays, there are many youth weightlifters in Thailand. The snatch technique in term of kinematics parameters for the elite youth is very important in weightlifting development.
Weightlifting requires a high power output to pull the bar to maximum height on both legs and bring it overhead with correct posture as specified in competition. Successful lifts may be described as those that maximized pull height after the second pull, and minimized the loss in height of the bar during the squat (Isaka et al.,1996 ; Safrushahar et al., 2002). The snatch involves lifting the bar to arm’s length above the head in one movement. The snatch is generally divided into five phases (Safrushahar et al., 2002). It starts at the lift
off position and progresses through the first pull, transition and second pull phase, to the squat, then the finish or hold position (Garret et al., 2000). This is the first time that study Thai youth women weightlifters for the snatch and the first study examine the overhead snatch from start to finish with maximum loading, revealing information that may not be seen from the naked eye of an experienced coach. The results of this study could showed the barbell trajectories of weightlifters, and kinematic variables with two-dimensional analysis. The vertical velocity of the barbell, particular peak velocity, is considered to have the same importance as the trajectory. Garhammer (1985) studied the trajectory pattern of barbell snatch lifts and clean and jerk for five Gold medalists in weightlifting at the 1984 Olympic Games. Therefore, the purpose of this study were to 1) Describe the snatch technique in term of kinematics of the barbell trajectory, and 2) Describe the barbell trajectory of maximum lifting. It was hypothesized that there are no differences between 6 youth women weightlifters in term of the movement pattern of lifting and the barbell trajectory of lifting in the snatch.

MATERIAL AND METHOD

Kinematics data were recorded by a 50 Hz digital video camera. The camera was position 5 m. from the center of the platform and mounted on steel posts and secured at a height of 0.95 meters from the floor to cover a full body view of the tallest subject. Peak 5. 2D Motion Analysis software were used to analyze the snatch lift. Kinematic variables including, barbell trajectory, barbell vertical, and barbell horizontal displacement, barbell peak height, barbell velocity, and barbell acceleration were then obtained.

Subjects

Six Thai Youth Weightlifters from National Weightlifting Team whom complete weightlifting during the Youth Olympic Games 2010, Singapore. They were healthy, and did not have any disorders affecting the lifter before taking part in this study. The performance of the athletes competing in 69-kg class and 48-kg class and the average age 15.8±0.25 years old and average height 161.0±0.3cm. the snatch attempts only once performance with the maximum lifting.

RESULT & DISCUSSION

The results showed that the average barbell peak height was 1.29±0.1m, vertical barbell displacement was 0.144±0.03m, horizontal barbell displacement was 0.180±0.28 m, maximum vertical barbell velocity was 2.37±0.26 m/s at 25±4 time % of total snatch, and maximum vertical barbell acceleration was 17.18±4.34m/s² at 27±6% of total snatch. Subject CHI who is the tallest had the maximum peak vertical velocity at 2.84 m/s during 31% of total snatch and the maximum peak vertical acceleration at 23.59 m/sec² during 29% of total snatch. The results showed the athletes who are taller tend to move the body and barbell greater distances and tend to move the barbell at higher speed. This result was similar to Drechster (1998) (Table 1). The vertical velocity of the barbell, particularly peak velocity is an important component for successful lifting as it is a main factor that contributes to peak bar height. This component has been observed for many years. Ono et al (1969) recognized that excellent lifters pull up the barbell at a higher speed toward the knee level (first pull), but a lower speed above the knee level (Ono et al, 1969). However, the results in this study showed that
the maximum vertical velocity among 6 weightlifters occurred during the pull above the knee area (2nd pull). Garhammer (1985) concluded that the barbell velocity of five gold medallists in weightlifting at the 1984 Olympic Games decelerated at the end of the first pull, due to rebending the knees and shifting of the torso to a more vertical position after the first pull and prior to the second pull. During this transition the vertical force on the barbell decreases, resulting in decreased barbell velocity. On the other hand, a smooth and fast transition results in a smaller decrement in velocity. From Figure 3-8 Acceleration of the barbell can provide interesting information for study and evaluation, such as the timing and direction of the applied force. Figure 8 showed that Subject SOP at the second peak of the vertical acceleration was a little higher value than the first peak. From the study of Isaka et al (1996), there were three peaks in the vertical acceleration that corresponded to the three phases of the pull movement (first pull, transition, and second pull). He concluded that the second peak of the vertical acceleration curve should have a higher value than the first peak. Garhammer (1985) showed that the barbell acceleration dropped just after the plates left the floor but then increased steadily to a maximum value just as hip torque began to decrease.

Perfection of lifting technique is commonly included in the daily routine of Olympic weightlifters. Although a major part of the training consists of submaximal loads, the lifts are also performed with maximum loads or near maximum loads (Hakkinen, 1988). It is important to investigate any alterations in the biomechanics of the snatch technique when loads are increased, and whether or not those changes might differ among female weightlifters of different skill levels.

Fig 1. Barbell Trajectory of the Snatch at maximum loading (112 kg) of Subject CHI
Fig 2. Barbell Velocity of the Snatch of CHI at maximum loading (112 kg).

Peak Velocity = 2.84 m/s at Time Percent Snatch = 31%

Fig 3. Barbell Acceleration of CHI at maximum loading (112 kg).

Peak Acceleration = 23.59 m/s² at Time Percent Snatch = 29%

Fig 4. Barbell Acceleration of SHO at maximum loading

Fig 5. Barbell Acceleration of RAT at maximum loading
Fig 6. Barbell Acceleration of SI at maximum loading

Fig 7. Barbell Acceleration of SUP at maximum loading

Fig 8. Barbell Acceleration of SOP at maximum loading

Table 1. Body weight, Barbell Peak Height, Vertical and Horizontal Barbell Displacement, Barbell Peak Velocity, and Velocity & Acceleration Time Total Snatch of the Snatch at maximum loading.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Body Weight (kg)</th>
<th>Barbell Peak Height (cm)</th>
<th>Vertical Barbell Displacement (cm)</th>
<th>Horizontal Barbell Displacement (cm)</th>
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<tbody>
<tr>
<td>CHI</td>
<td>117.00</td>
<td>1.60</td>
<td>0.174</td>
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<td>SHO</td>
<td>49.53</td>
<td>1.24</td>
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<td>1.34</td>
<td>0.152</td>
<td>0.0492</td>
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<tr>
<td>SI</td>
<td>49.55</td>
<td>1.14</td>
<td>0.148</td>
<td>0.063</td>
</tr>
<tr>
<td>SUP</td>
<td>50.25</td>
<td>1.26</td>
<td>0.075</td>
<td>0.031</td>
</tr>
<tr>
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<td>1.16</td>
<td>0.161</td>
<td>0.746</td>
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<tr>
<td>Subject</td>
<td>Body Weight (kg)</td>
<td>Barbell Peak Velocity (m/s)</td>
<td>Velocity Time Total snatch (%)</td>
<td>Acceleration Time Total snatch (%)</td>
</tr>
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<td>---------</td>
<td>-----------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>CHI</td>
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<td>2.84</td>
<td>31</td>
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<td>2.28</td>
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</tbody>
</table>

Fig 9. Barbell Trajectories of the Snatch at maximum loading of 6 Thai Youth Weightlifters
REFERENCES


การวิเคราะห์คิเนมัติกของบาร์เบลในการยกน้ำหนักสำเนาชุดสูงสุดของนักกีฬาเยาวชน

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บทคัดย่อ
กีฬายกน้ำหนักในประเทศไทยได้มีผู้ทำการศึกษาเฉพาะนักกีฬาในรุ่นประชาชน  โดยเฉพาะในนักกีฬาหญิงรุ่นประชาชน 2 คน ที่ได้รับเหรียญทองในกีฬาโอลิมปิก 2004 และ 2008 การศึกษาระดับพื้นฐานกีฬาในนักกีฬาเยาวชน หนึ่งจำนวน 6 คน วัยรุ่นน่านักศึกษา 69 กก. และ 48 กก. ที่เข้าร่วมคัดเลือกเพื่อเป็นตัวแทนประเทศไทยในการแข่งขันกีฬาโอลิมปิก 2010 ณ ประเทศฮ่องกง โดยศึกษาทางด้านคิเนมัติกของการเคลื่อนไหวของบาร์เบลในช่วงที่นักกีฬาที่สูงสุด 1 คน โดยใช้กล้องความเร็วสูง และโปรแกรมซอฟต์แวร์วิเคราะห์แบบ 2 มิติ ซึ่งประกอบด้วยทางการเดินทางของบาร์เบล การเปลี่ยนแปลงของบาร์เบลในแนวตั้ง และแนวขนาน ระยะทางสูงสุด อัตราความเร็ว และอัตราความเร่งของบาร์เบล ผลการศึกษาพบว่านักกีฬามีอายุเฉลี่ย 15.8 ปี ในการยกน้ำหนักที่สูงสุดของท่าสแนทซ์นั้น นักกีฬายกบาร์เบลที่สูงสุดคร่อมสูงสุด 0.144±0.03 เป็น 25±6 % ของช่วงที่ 2 และ 0.180±0.28 เมตร ตัวอัตราการดึงบาร์ในแนวตั้งมีความเร่งสูงสุดสูงสุด 2.84±0.26 เมตร/วินาที ที่ 31±4 %ของช่วงที่ 2 และ 23.59±4.34 เมตร/วินาที ที่ 29±6 %ของช่วงที่ 2


คำสำคัญ: คิเนมัติก  ท่าสแนทซ์  นักกีฬาเยาวชน